United States Court of Appeals
for the Second Circuit

EXHIBITS

UNITED STATES
DEPARTMENT OF THE INTERIOR

76-6122

FINAL
ENVIRONMENTAL STATEMENT

B

Volume 3 of 4

Proposed
1976 OUTER CONTINENTAL SHELF
OIL AND GAS LEASE SALE
OFFSHORE THE MID-ATLANTIC STATES

OCS SALE No. 40

UNITED STATES COURT OF APPEALS
FILED
SEP 14 1976
A. DANIEL FUSARO, CLERK
SECOND CIRCUIT

Prepared by the
BUREAU OF LAND MANAGEMENT

Curt Berklund
Director

VOLUME 3

TABLE OF CONTENTS

Page

IX. CONSULTATION AND COORDINATION WITH OTHERS 1
- A. Preparation of the Draft Environmental Statement . . . 1
  - 1. Federal Agencies 1
  - 2. State and Local Governments 2
  - 3. Professional and Industry Firms and Associations, Academic Institutions, Public Interest Groups, and Others 6
  - 4. Review of Working Draft of the Draft Environmental Impact Statement 8
- B. Coordination and Review of the Draft Environmental Statement Leading to Preparation of the Final Environmental Statement 10
  - 1. Coordination During the Review of the Draft Environmental Statement 10
  - 2. Public Hearing 10
  - 3. Written Comments Received 12
  - 4. Review and Analysis of Comments Received 13
    - • Issues Concerning Major Assumptions Underlying the Impact Analysis 15
    - • Issues Concerning Omissions in the Description of the Environment 19
    - • Issues Concerning Elements of the Impact Analysis . 24
    - • Issues Concerning Mitigating Measures 42
    - • Issues Concerning Alternatives to This Proposal, Excluding Certain Procedural Alternatives 59
    - • Issues Concerning Leasing Procedures and Management of OCS Oil and Gas Operations Pertaining Specifically to This Proposed Sale 62
    - • Issues Concerning Overall Departmental Policy on OCS Leasing Procedures and Management of OCS Oil and Gas Operations 66
  - 5. Federal Agencies 76
    - • Department of Commerce 77
    - • Department of the Army Corps of Engineers 93
    - • U.S. Coast Guard 95
    - • Department of Transportation, Materials Transportation Bureau 101
    - • Energy Research and Development Administration . . 103
    - • Nuclear Regulatory Commission 134
    - • Federal Energy Administration 135
    - • Environmental Protection Agency 138
    - • National Aeronautics and Space Administration . . . 155
    - • U.S. Geological Survey 156
    - • U.S. Fish and Wildlife Service 171
    - • Bureau of Mines 178
    - • National Park Service 179
    - • Bureau of Outdoor Recreation 180

6. State Agencies 181
- State of New York Department of Law 182
- New York State Department of Environmental Conservation 210
- State of New Jersey Department of Environmental Protection 241
- State of Delaware 275
- State of Maryland Executive Department 293
- Commonwealth of Virginia Council on the Environment 317

7. Selected Other Comments Received 327
- Atlantic Richfield Company 328
- National Wildlife Federation 343
- Monmouth County (New Jersey) Environmental Council 350
- Offshore Operators Committee 354
- Rutgers University Marine Sciences Center 357
- Middlesex County (New Jersey) Planning Board . . . 366
- John H. McDermitt (Paterson, New Jersey) 380
- Natural Resources Defense Council, Inc. 383
- National Coalition for Marine Conservation, Inc. . 435
- Long Island (New York) Environmental Council . . . 444

8. Public Hearing Log 450
9. Written Comments Log 462

BIBLIOGRAPHY 474

APPENDICES 522
1. Call for Nominations and Tentative Tract Selection for Mid-Atlantic OCS Sale #40 523
2. Memorandum of Understanding Between Bureau of Land Management and U.S. Geological Survey for OCS Pipelines 530
3. Secretarial Order No. 2974 535
4. Oil and Gas Operations 540
5. Memorandum from Mobil Oil Canada, Ltd. to Exxon Company, U.S.A. 592
6. Soil Limitations 596
7. Summary of U.S. Coast Guard Regulations Concerning Offshore Structures as Hazards to Navigation 600
8. Traffic Separation Schemes: New York and New Jersey Harbor, Delaware Bay, and Chesapeake Bay 603
9. Influences of Petroleum Hydrocarbons and Heavy Metals on Marine Food Webs 615
10. Matrix Tables 699
11. Proposed Operating Orders - Mid-Atlantic Outer Continental Shelf 719
12. Title 30 Code of Federal Regulations Part 250.34, Drilling and Development Program 784

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price $8.10
Stock No. 024-011-00082-8

IX. CONSULTATION AND COORDINATION WITH OTHERS

A. Preparation of the Draft Environmental Statement

1. Federal Agencies

Numerous Federal agencies were contacted for information and suggestions throughout the environmental assessment and statement preparation process. Agencies with the most direct interest were also invited to review sections of the working version of the draft impact statement (listed in Section IX.A.4).

Federal agencies contacted include:

Department of Agriculture
  Forest Service
  Soil Conservation Service

Department of Commerce
  National Oceanic and Atmospheric Administration
    Marine Ecosystems Analysis Program (MESA)
    National Data Buoy Center
    National Marine Fisheries Service
    National Oceanographic Data Center
    National Weather Bureau
    Office of Coastal Zone Management

Department of Defense
  U.S. Army Corps of Engineers
  U.S. Navy
    Eastern Sea Frontier Commander
    Naval Oceanographic Office

Department of the Interior
  Bureau of Mines
  Bureau of Outdoor Recreation
  Fish and Wildlife Service
  Geological Survey
  National Park Service

Department of Transportation
  Federal Aviation Administration
  U.S. Coast Guard

Environmental Protection Agency
Region II
Region III
Office of Research and Development

Federal Energy Administration

Smithsonian Institute

2. State and Local Governments

In July, 1974, a letter from the BLM New York OCS Office was sent to the Governors' designated contacts in the Mid-Atlantic States, requesting data and information regarding key state programs and resources. These requests were followed by direct requests to specific State agencies and visits to various agencies to collect information.

In November, 1974, a letter to county governments and regional planning commissions was sent, requesting information on land use plans and critical environmental areas. Subsequent requests were made to these agencies asking for population, socio-economic and other pertinent information.

Continued liaison with state agencies has been maintained. In some cases, contact and information has been provided through a single State agency serving as a clearinghouse for all data requests and input. In other cases, the New York OCS Office contacted individual state agencies each time information or input was needed. The process followed in each case was that requested by the individual or agency named by the respective Governor to coordinate with the New York OCS Office regarding OCS activities. Meetings were held with representatives of one or more agencies of the Mid-Atlantic states as a group (exclusive of conferences regarding environmental baseline studies) on three occasions: January 8, May 9, and May 27, 1975. These meetings were arranged to discuss the scope, assessment procedures, data needs, and coordination mechanisms with regard to the environmental impact statement. In July, 1975, a working draft of the Desecription of the Proposal (Section I) and a part of the DEIS regarding causes of environmental impact (now Sections III.A.1. and III.D. 1.a.) were circulated to State agencies for review. In August and September, 1975, respectively, preliminary drafts of Sections I-III and Sections IV-VIII were sent to State agencies for review. In all cases, these sections of the DEIS were working versions, for which identification of data omissions, errors, and suggestions for completeness were requested. Subsequent to review by the States, staff members of the BLM New York OCS Office travelled to the States to discuss suggestions and problems identified by each of the States.

Contacts through BLM-sponsored meetings, meetings at the State level, and direct solicitation of information were made to numerous State and local governmental agencies, including, but not limited to those listed below.

State Agencies

Delaware:
- Department of State, Division of Historic and Cultural Affairs
- Department of State, Division of State Planning
- Department of Natural Resources and Environmental Control
- Geological Survey

Maryland:
- Department of Economic and Community Affairs
- Department of Natural Resources
- Department of State Planning
- Historical Trust
- Port Authority

New Jersey:
- Department of Community Affairs
- Department of Environmental Protection
- Department of Labor and Industry
- State Museum

New York:
- Department of Commerce
- Department of Environmental Conservation
- Department of Public Services
- Office of Parks and Recreation
- State Museum and Science Service

Virginia:
- Air Pollution Control Board
- Bureau of Solid Waste and Vector Control
- Commission of Game and Inland Fisheries
- Commission on Outdoor Recreation
- Coordinator, OCS Activities
- Council on Environmental Quality
- Department of Agriculture and Commerce
- Department of Health
- Department of Highways and Transportation
- Division of Industrial Development
- Division of Mineral Resources
- Division of State Planning
- Historic Landmarks Commission
- Institute of Marine Sciences
- Water Control Board

County and Regional Planning Agencies

New Jersey County Planning Boards:
- Atlantic County
- Burlington County
- Camden County
- Cape May County
- Cumberland County
- Gloucester County
- Hudson County
- Mercer County
- Middlesex County
- Monmouth County
- Ocean County
- Passaic County
- Salem County
- Union County

Maryland County and Regional Planning Agencies:
- Anne Arundel County Office of Planning and Zoning
- Baltimore County Planning Board
- Baltimore Regional Planning Commission
- Calvert County Zoning Commission
- Caroline County Planning Commission
- Cecil County Planning Commission
- Charles County Planning Commission
- Dorchester County Planning and Zoning Commission
- Harford County Department of Planning and Zoning
- Maryland National Capital Park and Planning Commission
- Queen Anne's County Planning Commission
- St. Mary's County Planning and Zoning Commission
- Somerset County Planning and Zoning Commission
- Talbot County Planning and Zoning Commission
- Tri-County Council for Southern Maryland
- Salisbury-Wicomico Planning and Zoning Council
- Worcester County Planning and Zoning Council

Virginia Planning District Commissions:
- Accomack-Northampton
- Crater
- Middle Peninsula
- Northern Neck
- Rappahannock Area Development Commission
- Southeastern Virginia

Delaware County Planning Commissions:
- Kent County
- New Castle County
- Sussex County

Other Regional and Interstate Agencies

Delaware River Valley Planning Commission
Interstate Sanitation Commission
Nassau County Museum
Nassau-Suffolk Regional Planning Commission
Nassau-Suffolk Regional Marine Resources Council
New York City Department of Environmental Protection
Port Authority of New York and New Jersey
Tri-State Regional Planning Commission
Wilmington Metropolitan Area Planning Commission

3. Professional and Industry Firms and Associations, Academic Institutions, Public Interest Groups, and Others

In November, 1974, a letter was sent from the BLM New York OCS Office to the many agencies and offices in the Mid-Atlantic region explaining that the Office was commencing work on an environmental assessment for the purpose of preparing an environmental impact statement on proposed Sale #40. Interested parties who felt that they could contribute input to the draft environmental statement were invited to designate a contact and indicate interest.

In the course of the environmental assessment and draft statement preparation process, numerous agencies, companies, individuals, and institutions were contacted for information.

In August and September, 1975, at the time when invitations were extended to State and Federal agencies to review the working draft of the draft EIS, groups which had at some time expressed an interest in providing input into the statement were invited to review the working draft (listed in Section IX.D. below). Two sessions of two days each were established for this review.

Institutions, associations, and groups which were contacted for information or input include, but are not limited to the following:

American Gas Association
Alpine Geophysical Associates
American Geographical Society
American Littoral Society
American Museum of Natural History
American Petroleum Institute
American Telephone and Telegraph
Amoco Production Company
Atlantic Offshore Fish and Lobster Association
Atlantic States Marine Fisheries Commission
Baroid
BBN Geomarine Services
Brookhaven National Laboratory
Columbia University
Continental Oil Company
Cornell University
Dames and Moore
E. I. DuPont, DeNemours, and Company
E. G. & G.
Exxon Company, U.S.A.
Friends of the Earth
Gulf Oil Company
I. C. Holland Dredging
Interstate Natural Gas Association
Johns Hopkins University
Long Island Environmental Council
Massachusetts Institute of Technology
McClelland Engineers
J. Ray McDermott Company
Mobil Oil Company
Murphy Pacific Marine Salvage
National Audubon Society, Regional Representative
National Ocean Industries Association
National Wildlife Federation
Natural Resources Defense Council
New Jersey Petroleum Council
New Jersey Public Service, Electric and Gas
New York State Petroleum Council
New York University
Offshore Operators Committee

Polytechnic Institute of New York
Raytheon, Inc.
The Research Institute of the Gulf of Maine
Rutgers University
Sandy Hook Pilots
Sierra Club, Atlantic Chapter
State University of New York at Stonybrook
Sun Oil Company
Tetra Tech
Texaco, Inc.
University of Delaware
University of Maryland
University Institute of New York
Virginia Institute of Marine Sciences
Watch Our Waterways
Woods Hole Oceanographic Institute
Woodward, Gardner, and Associates

4. Review of Working Draft of the Draft Environmental Impact Statement

The following agencies and groups were invited to review the working draft of the draft environmental impact statement for the purposes of identifying any errors and omissions, or making any suggestions for completeness prior to the draft statement's submission to the Washington BLM headquarters office for formal review and submission to the Council on Environmental Quality.

In the case of the five Mid-Atlantic States, copies of the working draft were sent to the designated contacts within each State to coordinate the review by the various State agencies. In September and October 1975, staff members of the BLM New York OCS Office met with State personnel in each of the five States on two separate occasions to discuss the comments and suggestions that each of the States had after reviewing the working draft.

Federal

- Department of Commerce
  - National Oceanic and Atmospheric Administration
    - Marine Ecosystems Analysis Program (MESA)
    - National Marine Fisheries Service
- Department of Defense
- Department of the Interior
  - Bureau of Outdoor Recreation
  - Fish and Wildlife Service
  - Geological Survey
  - National Park Service
- Department of Transportation
  - U.S. Coast Guard
- Environmental Protection Agency

State and Regional Agencies

- Delaware Geological Survey
- Delaware State Planning Office
- Maryland Department of Natural Resources
  - Coastal Zone Management Program
  - Geological Survey
- New Jersey Department of Environmental Protection
- New York Department of Environmental Conservation
- Virginia Council on Environmental Quality
- Virgnia OCS Coordinator
- Delaware Valley Regional Planning Commission
- Nassau-Suffolk Regional Marine Resources Council
- Tri-State Regional Planning Commission
- Wilmington Metropolitan Area Planning Commission

Other Institutions and Groups

- American Littoral Society
- American Petroleum Institute
- Atlantic Offshore Fish and Lobster Association
- Friends of the Earth
- Long Island Environmental Council
- National Audubon Society, Regional Representative
- National Wildlife Federation
- Natural Resources Defense Council
- New Jersey Petroleum Council
- New York State Petroleum Council
- Sierra Club, Atlantic Chapter
- Watch Our Waterways

B. Coordination and Review of the Draft Environmental Statement Leading to Preparation of the Final Environmental Statement

1. Coordination During the Review of the Draft Environmental Statement

The draft environmental impact statement was completed in the fall of 1975 and was filed with the Council on Environmental Quality on December 10, 1975. A Notice of its availability was published in the Federal Register on the same date. Approximately 1,400 sets of the three-volume draft statement were distributed to Federal, State and local agencies, U.S. Congressmen, State officials, industry organizations, libraries, conservation and environmental groups, and others. Comments were requested concerning the draft environmental impact statement and the proposal, and could be submitted by February 17, 1976.

2. Public Hearing

A public hearing was held in Atlantic City, New Jersey, on January 27, 28, 29, and 30, 1976. The purpose of this hearing was to receive views, comments, and suggestions relative to the environmental impact statement and the proposed action as part of the OCS accelerated leasing program. Charles C. Moore, Administrative Law Judge from the Department of the Interior's Office of Hearings and Appeals, Arlington, Virginia, conducted the hearing. A panel of officials representing the Secretary's Office, U.S. Department of the Interior, the Bureau of Land Management, the U.S. Geological Survey, and the U.S. Fish and Wildlife Service received the testimony.

At the conclusion of each person's testimony, if desired, members of the hearing panel questioned the witness to clarify or expand witness testimony.

Total oral testimony at the public hearing was given by 137 persons. A complete official transcript of the hearing plus written comments received are available for public inspection at the Bureau of Land Management in the New York Outer Continental Shelf Office, in New York, New York, and in Washington, D.C.

The following is a brief summary of the general issues raised at the public hearing:

(1) concern for recreation and tourism resources, particularly in Southern New Jersey;

(2) lack of knowledge concerning environmental impacts of the proposal;

(3) concern for placement of OCS-related onshore support facilities that may be needed--that they not be located in fragile shore areas;

(4) the amount of resources available should be determined more accurately first; several speakers felt that the Federal Government should do its own exploratory drilling to determine more realistic oil and gas resources prior to any leasing for development and production;

(5) inadequate consideration of indirect and/or secondary socioeconomic and environmental impacts onshore;

(6) the need for a comprehensive liability fund and/or revenue sharing program with the States and local areas that may be affected by oil spill impacts and the pressures of furnishing additional infrastructure as a result of OCS development;

(7) the need for a national energy policy, including conservation and other energy alternatives, to better analyze the need for OCS development for long-range national energy needs;

(8) concern for more jobs and a more secure supply of energy in this Mid-Atlantic area;

(9) the lack of State and local input and consideration in OCS planning and decisionmaking;

(10) the need for completion of baseline environmental studies to gain knowledge on the environment in this Mid-Atlantic area; and,

(11) the Coastal Zone Management Plans for each of the States should be finalized and implemented prior to any OCS leasing so that State and local input into OCS planning can be more effective.

3. Written Comments Received

In addition to comments received at the public hearing, over 185 written comments were received as a result of solicitation by news releases, Federal Register Notices, distribution of the draft statement, and in connection with the public hearing. It is difficult to estimate the total number of persons represented by these written comments as many letters were from conservation and environmental protection groups, local citizens groups, and industrial organizations.

4. Review and Analysis of Comments Received

Comments and testimony were received from a diverse group of individuals, groups, organizations, companies, and local, State, and Federal agencies. Comments ranged from support of the statement and the proposal to requests for major revisions of the statement and postponement or withdrawal of the proposal.

The latter portion of this chapter contains copies of correspondence received from Federal agencies, State Governments and agencies, and other representative organizations and groups that were felt to represent the concerns regarding the draft impact statement and the proposed action. A listing of persons testifying at the public hearing, and a listing of all written comments received are also included at the end of this section.

All comments and letters received were first reviewed relative to either corrections and editorial changes to the draft statement or issues raised. Where possible and appropriate, the environmental statement has been revised to correct errors and omissions, and to clarify and/or augment discussion of issues of concern. All substantive issues were analyzed to determine revisions necessary to strengthen and improve upon the draft statement. Wherever possible, the final statement reflects consideration given to these issues.

Summarizations and responses to the specific issues of major concern are presented below. For convenience, they have been grouped in the following manner:

(1) Comments concerning the adequacy of the environmental impact statement:

  (a) regarding major assumptions underlying the impact analysis;

  (b) regarding major omissions in the description of the environment which may be impacted as a result of this proposal;

  (c) regarding elements of the impact analysis;

  (d) regarding mitigating measures; and

  (e) regarding alternatives to this proposal, excluding certain procedural alternatives.

(2) Comments concerning leasing procedures and management of OCS oil and gas operations as they pertain specifically to this proposed sale.

(3) Comments concerning overall Departmental policy on OCS leasing procedures and management of OCS oil and gas operations.

ISSUES CONCERNING MAJOR ASSUMPTIONS UNDERLYING THE IMPACT ANALYSIS

ISSUE: #1 The estimated range of resources discussed in the DES is too wide to provide meaningful discussion of offshore and onshore facilities that will be required, and thus is too wide to provide adequate evaluation of the impacts of this proposal.

Raised by:
State of New Jersey
James J. Howard (U.S. House of Representatives, New Jersey)
Ocean County Board of Chosen Freeholders, New Jersey
Middlesex County Planning Board, New Jersey
Cape May County Planning Board, New Jersey
Long Island Environmental Council, New York

Response: The EIS has utilized the range of estimates provided by the Geological Survey, based on proprietary geophysical data, for the tracts under consideration for leasing. In addition, an earlier, larger estimate of potential undiscovered recoverable resources which was felt might result from a first Baltimore Canyon sale has been utilized in the impact analysis. This estimate was retained for use in the analysis, in order that potential adverse impacts of this sale would not be underestimated. In early discussions with the Mid-Atlantic States, a desire was expressed for scenarios utilized for impact analysis to include not only a "most reasonable" case, but minimum and maximum cases as well.

Table I-1 has been revised to indicate the range of facilities and activities considered most likely to result from this proposed sale (based on the latest Geological Survey estimates of undiscovered recoverable resources of between 0.4 and 1.4 billion barrels of oil and 2.6 to 9.4 trillion cubic feet of gas). The table indicates separately the facilities and activities which might result from the higher resource estimates, should the sale be held (2.6 billion barrels of oil and 12.8 trillion cubic feet of gas). Section III.A. has also been revised to further clarify use of resource estimates in analyzing potential impacts of the proposed sale.

ISSUE: #2 The FES should provide discussion on the results of other studies analyzing the potential impacts of Baltimore Canyon development.

Raised by: State of Maryland

Response: This environmental statement is concerned with the proposed action, one sale in the Baltimore Canyon consisting of 154 tracts. Other studies of the potential impact of OCS development of the Baltimore Canyon have dealt with development of the Baltimore Canyon Trough. These studies include 1) The Council on Environmental Quality's Oil and Gas -- An Environmental Assessment, 2) The University of Delaware's (Joel Goodman, ed.) Decisions for Delaware: Sea Grant Looks at OCS Development, 3) Woodward-Clyde Consultants' Mid-Atlantic Regional Study: An Assessment of the Onshore Effects of Offshore Oil and Gas Development, and 4) The Office of Technology Assessment's recently released Coastal Effects of Offshore Energy Development: Oil and Gas Systems (for which backup "working papers" are not yet available). All of the studies available at the time of the writing of the statement were analyzed for comparisons of assumptions, methodologies, etc. Many of the methodologies and/or assumptions utilized in other studies make their applicability or comparison to this statement and its impact analysis difficult. A brief discussion of some of the study results is contained in Section III.H. of the FES. A discussion of the methodologies and results of the RPA/CEQ study is also contained in the Final Environmental Impact Statement for the Proposed Increase in Oil and Gas Leasing on the Outer Continental Shelf.

ISSUE: #3 The DES assumption that Mid-Atlantic OCS oil will replace barrel-for-barrel foreign oil is questionable due to the growth in demand for oil that can be expected to occur in the Mid-Atlantic region. Therefore, the assumption that no new refineries will be required as a result of the proposed action is questionable.

Raised by:
U.S. Coast Guard, Department of Transportation
Energy Research and Development Administration
Environmental Protection Agency, Region II, New York
State of New York
State of New Jersey
State of Delaware
State of Maryland
Commonwealth of Virginia
Middlesex County Planning Board, New Jersey
Cape May County Planning Board, New Jersey
Long Island Environmental Council, New York
James J. Howard (U.S. House of Representatives, New Jersey)
Natural Resources Defense Council, Inc.
American Littoral Society
League for Conservation Legislation (New Jersey)
National Coalition for Marine Conservation, Inc.

Response: The discussion of the proposed action and its relationship to new refinery development has been revised to clarify the Department of the Interior's analysis and reasoning for this assumption. The FES does not assume that there will be no increase in demand for crude oil or petroleum products. There may be increases in demand, unrelated to OCS development. Any additional refinery capacity in the Mid-Atlantic would be a result of an increase in demand, rather than OCS production, as ample refinery capacity presently exists to handle even the maximum peak daily production which would result from the high resource case. In addition, the FES discussion points out recent trends which call into question the likelihood of demand for increased refinery capacity. The FES also points out that while any OCS production may not reslut in a barrel-for-barrel replacement of existing foreign imports, it would represent replacement of foreign imports which would be required in the absence of OCS production.

ISSUE: #4 **The DES assumption that tanker traffic would decrease due to the use of pipeline transport of this OCS oil is questioned.**

Raised by:
U.S. Coast Guard
State of New York
State of New Jersey
State of Delaware
Commonwealth of Virginia
National Wildlife Federation
Natural Resources Defense Council, Inc.
National Parks and Conservation Association
Sierra Club, Northeast Region
Office of the Supervisor, Islip, New York

Response: The DES assumption that tanker traffic would not change appreciably as a result of this sale is based on the assumption that any OCS produced oil would be replacing otherwise required foreign imports of oil transported by tanker. The statement does recognize that if tankers have to be used, crude oil may mean a slight increase in the amount of vessel traffic.

ISSUES CONCERNING OMISSIONS IN THE DESCRIPTION OF THE ENVIRONMENT

ISSUE: #1 The description of biological communities should follow a community/systems approach, discussing communities by ecosystem rather than state.

Raised by: U.S. Fish and Wildlife Service
State of New York

Response: A community systems approach has been utilized to the best extent possible. Each group of organisms, (zooplankton, benthos, etc.) is described by habitat with a discussion of environmental factors influencing the distribution of the organisms.

ISSUE: There is a lack of quantification of marine and estuarine
#2 populations in the DES.

Raised by: State of New York
Atlantic Richfield Oil Company

Response: Accurate quantification of marine and estuarine populations is not available due to insufficient methodologies in population census techniques for these types of organisms. Furthermore, quantification for most species would not be meaningful in and of itself due to the dynamics of the ocean currents, wave action, wind and mobility of species which allow for constant mixing and rapid repopulation of disturbed areas in most cases.

ISSUE: #3

The FES should include Chesapeake Bay as an area which may be impacted by the proposed sale. Chesapeake Bay is a vital part of the Mid-Atlantic from an environmental standpoint, particularly as it relates to Mid-Atlantic fisheries resources. In light of the following activities and/or proposed activities, Chesapeake Bay is very likely to experience impacts as a result of the proposed sale: 1) proposed Brown and Root platform fabrication facility in Northampton County, Virginia; 2) proposed Hampton Roads Energy Company refinery in Hampton Roads area of Virginia; 3) proposed expansions of Steuart Petroleum Company oil-handling facilities on the Potomac River; 4) expansion plans of Amoco refinery in Yorktown, Virginia; 5) the enlargement of the Chesapeake and Delaware Canal, resulting in increased capabilities of the ports of Baltimore and Hampton Roads to accommodate larger vessels and increased commerce; and 6) possible construction of OCS drilling rigs at Bethlehem Steel's Sparrow's Point, Maryland, site. The use of the Hampton Roads area as a site for analysis of onshore impacts of Baltimore Canyon OCS development by API in a contracted study was also cited.

Raised by:

U.S. Fish and Wildlife Service
U.S. National Marine Fisheries Service
State of Maryland
Commonwealth of Virginia

Response:

The Chesapeake Bay has now been included in the Description of the Environment, Section II. Section III, Environmental Impacts of the Proposed Action, contains generic discussions of potential impacts on different types of resources, with an attempt to indicate which specific resources and in what areas these impacts are considered most likely to occur. (See particularly Section III.D.1.a.). Because of the location of the proposed tracts, it is not felt that Chesapeake Bay is likely to receive extensive direct impacts as a result of the proposed sale. In its analysis, the API study does not consider the tracts included in the proposed action, but development of the entire Baltimore Canyon area, (discussed in the FES in Section III.H.). The factors listed by commenters as reasons that Chesapeake Bay is likely to experience impacts are for the most part unrelated to this proposed action. They do not take into account that while the Chesapeake Bay area may be the site of existing and future petroleum activities, the location of the tracts proposed for leasing and the availability of more convenient localities for required services and onshore facilities, make it unlikely that Chesapeake Bay will be directly effected as a result of this proposed sale. Section III.D.1.a. also contains a discussion of platform fabrication facilities.

ISSUE
#3 (cont.)

The impact analysis contained in Section III. is a generic one which may be applied to specific areas. We have attempted to define those elements of activities and facilities which could generate impacts (specifically Sections III.A. and III.D.1.a.), and those factors in a given region or environment which would determine the types and levels of impacts received. Applications to specific areas have been made by way of example. In addition, areas or types of areas most likely to receive primary OCS-related facilities have been defined as much as possible (see Section III.D.1.a.). While we do not believe that Chesapeake Bay is likely to receive significant direct impacts as a result of this proposed sale, the impact analysis contained in Section III, regarding both direct and secondary impacts, may be applied to the Chesapeake Bay area.

ISSUE: #4 Foreign commercial fishing data and activities are not discussed in the DES.

Raised by:
National Marine Fisheries Service
State of New Jersey
National Coalition for Marine Conservation, Inc.
American Littoral Society
New England Fisheries Steering Committee
Citizens Energy Coalition of New Jersey

Response: Section II.G.1.f. has been expanded to include information on foreign commercial fisheries. Presently, accurate and specific data on the extent of foreign commercial fisheries activities in the Mid-Atlantic area are not available in detail. Discussion of future foreign fisheries activity is also included in Section II.H.

ISSUE: #5 The DES does not adequately describe birds, particularly pelagic birds which are most likely to be effected by the proposed action. Pelagic birds should not be discussed with onshore and coastal birds.

Raised by:
U.S. Fish and Wildlife Service
State of New Jersey

Response: To avoid needless duplication, two very thorough references on avifauna were cited. These references (Heppner and Gould, 1973 and TRIGOM, 1974) discuss species present, distribution of species, quantitative abundance and life history information. The Bureau of Land Management believes that the description of avifauna presented provides adequate detail to serve as a context for impact evaluation. Impacts on nearshore and coastal, and pelagic birds has been discussed in one section because the generic impacts to all of these bird groups as a result of potential contamination by oil is the same. The factors effecting the means by which and levels of which these groups of birds may be effected is also discussed.

ISSUES CONCERNING ELEMENTS OF THE IMPACT ANALYSIS

ISSUE: #1 The DES does not adequately discuss the onshore impacts that will occur from this Mid-Atlantic proposal. The facility requirements and onshore siting locations are discussed too generally to be meaningful.

Raised by:
State of New York
State of Maryland
State of New Jersey
State of Delaware
Commonwealth of Virginia

Response: Although the BLM has no direct authority onshore except for areas which it administers (e.g., public trust lands), the EIS nevertheless discusses potential onshore impacts in Section III.D. It is difficult to determine the exact nature, scope, extent and magnitude of potential onshore impacts until after exploratory drilling has occurred, commercial quantities of oil and gas have been found, and specific development plans are submitted by the lessee to the USGS for approval. Site-specific information contained in the development plans will be submitted to adjacent States for review and comment prior to approval by the USGS in accordance with 30 CFR Part 250.34. The Department, through the USGS, has the discretion of undertaking an environmental assessment of the development plans, and if the activities are felt to consist of extensive significant actions, an environmental assessment record (EAR) will be prepared. If it is determined after an EAR has been prepared that the proposed activities constitute a major Federal action significantly effecting the quality of the human environment an EIS will be prepared pursuant to NEPA and CEQ requirements.

ISSUE: #2 **The DES discussion of onshore impacts is inadequate because it fails to indicate specific localities where impacts are likely to occur.**

Raised by: New York Department of Law

Response: The FES has made every attempt to indicate likely general locations of onshore development, based on parameters affecting facility location. (See in particular Section III.D.1.a.) However, because locations of potential onshore development cannot be predicted with any certainty until development plans are prepared, a generic approach incorporating examples of impacts to areas thought likely to be impacted has been taken. Also, see response to the issue above.

ISSUE: #3 **The DES discussion and analysis of onshore development most likely to occur in New Jersey (in only four counties) limits the adequacy of the impact analysis discussion of other possible areas of onshore development in the Mid-Atlantic.**

Raised by:
State of New Jersey
Commonwealth of Virginia
State of Maryland
Middlesex County Planning Board, New Jersey
Cape May County Planning Board, New Jersey
Sierra Club, Northeast Region

Response: The impact statement does not limit its discussion of impact analysis to four New Jersey counties. The analysis of impacts of onshore development uses as one tool an economic model which considered a "likely" onshore development scenario. The results of that study, are included in Technical Paper No. 1: Economic Study of the Possible Impacts of a Potential Baltimore Canyon Sale, prepared by the New York OCS Office of the Bureau of Land Management. That study is not a part of the environmental impact statement. The analysis of impacts in the EIS is a generic one which seeks to analyze the types and levels of impacts which might be experienced by different resources as a result of the proposed sale. In using the approach, the statement outlines the factors and parameters which would determine these impacts and indicates conclusions regarding likely resources to be impacted and likely localities to be impacted. Because of the factors and parameters discussed, it is felt that many potential impacts could occur in New Jersey, but also includes other areas which it is felt the potential impacts could occur, as well as generic discussions which could be applied to all areas.

ISSUE: #4 The DES estimates of onshore facility needs, land use demands, and infrastructure and employment needs appear to underestimate the Mid-Atlantic OCS proposal development needs.

Raised by:
Environmental Protection Agency
Commonwealth of Virginia
State of Maryland
Natural Resources Defense Council, Inc.
Rutgers University, Marine Sciences Center

Response: The estimates of needs provided in the environmental statement are specific as to what facilities and assumptions are included. The estimates do not attempt to include all indirect and secondary effects in all cases, but omissions are noted and where quantification of some impacts is not felt possible, this is noted. A discussion of platform fabrication facilities and refineries may be found in Section III.D.1.a.

ISSUE: #5 The DES discusses natural gas and oil production only from the production platforms to the facilities onshore, no further.

Raised by: State of New Jersey

Response: This site-specific EIS discusses all impacts which could be traced directly to this proposed sale. It would be impractical and of little use in understanding the impacts of this proposed sale to pursue the analysis beyond this point. Oil and gas from this proposed sale, once it leaves the onshore facilities described, will enter the existing infrastructure of petroleum processing and transportation facilities. Production from this proposed sale is expected to replace imported sources rather than causing an increase in refinery capacities in the Mid-Atlantic area. Any change in the overall refinery capacity of the area would be a function of demand, not a result of this proposed sale. To discuss the oil and gas flow beyond its entry would distort the analysis of the impacts of this Mid-Atlantic proposal as required by NEPA.

Section III.D.1.a. has been amended to give recognition to the requirement of pipelines from processing plants to existing transmission systems.

ISSUE: #6 The DES does not adequately distinguish the lesser impacts of gas production versus those of oil production on the OCS.

Raised by: State of Maryland
Eugene M. Luntey (American Gas Association)
Robert M. Welch, Jr. (Columbia Gas System Service Corporation)
Merle W. Arr (Interstate Natural Gas Association of America)

Response: The statement indicates impacts of individual aspects of OCS oil and gas operations. However, no discussion of the lesser impacts of gas operations alone is provided because before exploratory drilling occurs, it is not possible to ascertain whether oil, gas, a combination of oil and gas, or no resources are actually located in the Baltimore Canyon. To make a decision to lease OCS lands based on the lesser impacts of gas operations would neglect the possibility that greater impacts due to the discovery of oil may occur.

ISSUE: #7 **The DES does not have adequate information concerning the extent and severity of oil spills and resultant impacts due to offshore pipelines.**

Raised by: Environmental Protection Agency
U.S. Coast Guard
Natural Resources Defense Council, Inc.

Response: The FES has utilized the best information available in discussing possible pipeline spills, and in addition has noted in its impact analysis those resources most susceptible to spills from pipeline accidents. However, since most historical data does not take into account recent improvements in pipeline technology and new regulations, and because this FES includes a stipulation requiring burial of all pipelines whenever technically and economically possible, predictions as to spill rates cannot be made with any accuracy; nevertheless, these requirements should lessen the probabilities of pipeline spills.

Section III.A.4. discusses and presents probabilities concerning possible oil spills and their potential impact on the Mid-Atlantic shoreline and coastal environment. Section IV.C. discusses the technology and status of oil spill containment equipment and contingency plans in the Mid-Atlantic region.

ISSUE: #8 The FES should provide more specific information regarding pipeline corridor studies, anticipated landfall zones, and resulting offshore and onshore impacts in the Mid-Atlantic area.

Raised by:
State of Maryland
Herbert Bulhler, New Jersey State Senator
Cape May County Planning Board, New Jersey
Charles D. Worthington, County Executive, Atlantic City, New Jersey
Borough of Lavallette, New Jersey
Committee Against Oilports on the Bayshore (Middletown, New Jersey)

Response: The Bureau of Land Management's role in pipeline management on the OCS includes the responsibility for conducting pipeline routing studies and, with the concurrence of USGS, designating pipeline corridors on the OCS for all pipelines other than flow or gathering lines within the confines of a single lease or group of contiguous leases under unitized operation or a single operator. The procedures to be followed by the BLM and USGS will be those outlined in the "Memorandum of Understanding" and Secretarial Order No. 2974, included as Appendices 2 and 3 of this FES.

In order to fulfill the requirements of the pipeline corridor stipulation which will be included in all leases awarded as a result of this proposed sale, a pipeline management study will be initiated in the Mid-Atlantic to determine, in a macro-sense, the least environmentally hazardous areas in which to require the placement of pipelines. The basic goal of the study will be to develop an effective planning and management tool, which along with other decision input information, can be used to structure near-term pipeline development and locational schemes for leased tracts.

The corridor study is viewed as consisting of two-phases. The first phase will identify macro-corridors using existing data pertaining to the environmental setting of the area. The following procedures would be applicable during the first phase: 1) State expressions of alternative pipeline and ancillary facility requirements and locations; 2) Industry expressions of alternative pipeline and ancillary facility requirements and locations; and 3) Interfacing of above, analyzing areas of overlap and delineating macro-areas for linear development.

ISSUE:
#8 (cont.)

The second phase of the corridor study would be for the purpose of obtaining quantitative biological, chemical, geological, and physical baseline data within the macrocorridor routes. Initiation of this phase would be contingent upon the discovery of sufficient reserves in the Mid-Atlantic sale area to require construction of pipelines. If commercial reserves are discovered and the second phase of the study initiated, data collected during this phase will be assessed, and specific corridor routes finalized. Monitoring of the effects of specific pipeline installations within corridors will then be possible. Optimum pipeline development is partly a function of environmental capabilities (both offshore and onshore), operational and economic dictates, and transportation needs of the impacted area. Recognition of these parameters in a coordinated Federal-State-industry effort will result in pipeline sitings which recognize zones of least environmental impact and which are economically feasible according to articulated studies, plans, policies, and controls.

ISSUE: #9 **The Bureau of Land Management should not accept the premise that the shortest and cheapest pipeline route is the best. The shortest available pipeline route was sited numerous times in the DES as a major consideration in pipeline routing.**

Raised by: Environmental Protection Agency

Response: Distance and economic feasibility are indeed major considerations in determining pipeline routes. However, the DES did not mean to imply that absolute shortest distances to shore, especially if valuable resources would be encountered in landfalls for such a route, would be used. Indeed, since State and local jurisdictions would have to permit both onshore sections of pipelines and pipelines in State waters, pipeline landfalls in areas where they would cause great environmental impact are not likely.

However, the criterion of distance to shore was utilized to determine the broad general areas where pipelines may come ashore. This was done especially because landfalls influence the siting of some related onshore facilities. Considering the distance factor, together with other environmental factors, probable locations for these facilities could be discussed on a very broad level. Thus, it was determined that the New Jersey coast, the Delaware Atlantic coast, and possibly the Maryland Atlantic coast would be much more likely to receive onshore impacts as a result of this proposed sale than would areas further south.

ISSUE: #10 **The FES should further discuss and analyze oil spill trajectories in this Mid-Atlantic area.**

Raised by:
Environmental Protection Agency
National Marine Fisheries Service
U.S. Fish and Wildlife Service
Energy Research and Development Administration
Commonwealth of Virginia
State of New Jersey
State of New York
Sierra Club, Northeast Region
National Parks and Conservation Association

Response: Section III.A.4. of the FES contains an expanded discussion of the two Coast Guard oil trajectory models briefly discussed in the DES. This is as a result of an expanded analysis of these models which took place subsequent to the publication of the DES. The FES also briefly discusses the results of other trajectory models for the Mid-Atlantic, including a model directly analyzing this proposed Sale No. 40.

ISSUE: #11 The DES does not adequately discuss substances contained in drilling muds used in the drilling process, or formation water produced with oil. There should be further discussion of those substances which are toxic or may cause continuous low-level chronic effects on the offshore environment.

Raised by:
Environmental Protection Agency
State of New York
State of New Jersey
Monmouth County Environmental Council, New Jersey
State of Rhode Island, Governor's OCS Advisory Task Force
Long Island Environmental Council, New York
The Wilderness Society
American Littoral Society
National Parks and Conservation Association
National Coalition for Marine Conservation, Inc.

Response: Sections III.A. and B. of the FES have been revised to include more information on these substances. In addition, Appendix 9, Influences of Petroleum Hydrocarbons and Heavy Metals on Marine Food Webs, has been supplemented with more recent information and results of recent studies.

ISSUE: #12 The DES does not consider the toxic effects of heavy metals contained in formation waters produced; these effects need to be discussed in more detail.

Raised by:
Environmental Protection Agency
State of New York
State of Rhode Island, Governor's OCS Advisory Task Force

Response: The synergistic effects of heavy metal are not well understood. The impact analysis has been amended where appropriate to include more recent information on known effects. As mentioned above, Appendix 9 has been updated to include more recent information on the uptake and effects of heavy metals in the marine food web. A summary of the material in this appendix, concerning the uptake, metabolism and concentration of heavy metals in the marine food web has been added to Section III.B.

ISSUE: #13 The FES should discuss the release or resuspension of heavy metals, pesticides and other toxic materials that may be reintroduced into the marine environment, particularly in the event of pipelaying through ocean dumping sites which may effect marine organisms.

Raised by:
Environmental Protection Agency
Atlantic Richfield Oil
Natural Resources Defense Council, Inc.

Response: The possibility of release, suspension or resuspension of toxic materials does exist in the drilling and pipeline burial operations. The types and amounts of materials likely to be put into suspension by the various operations is almost entirely dependent upon the nature of the substrate that will be disturbed. Since this varies tremendously from site to site, this statement has not attempted to deal with specifics of the problem. Throughout the text, the FES has dealt with the general effects of these toxic substances. This is also discussed in Appendix 9 and Section III. (introduction). Site-specific evaluations of pipeline corridors would be conducted prior to granting permits for pipeline rights-of-way to assure that the least potential environmental impact possible would occur as a result of both pipeline burial and operation. Thus, a mechanism to analyze the effects of and to avoid pipeline burial in ocean dumping areas and other areas of localized contaminated sediments exists.

ISSUE: #14 The DES fails to address the conflicts of ocean dump sites and cumulative effects of offshore operations (oil spills, drilling muds, for example).

Raised by:
Cape May County Planning Board, New Jersey
Marine Environmental Council of Long Island

Response: The FES, in Section III.H., Cumulative Impacts of the Proposed Sale and Other Federal Actions, has been expanded to further address this issue.

ISSUE: #15 The FES should stipulate that ocean dump sites should not be traversed by pipelines.

Raised by: Cape May County Planning Board

Response: If recoverable quantities of oil and/or gas are discovered as a result of this proposed sale, the Bureau of Land Management would undertake pipeline corridor management studies. Consideration of the impact of any potential pipeline placement through ocean dumping areas would be given before a permit for a pipeline was granted.

ISSUE: #16 The DES discussion of tourism and the tourism economy is inadequate. In particular, the data generated by the BLM study contracted to the U.S. Travel Data Center is inadequate, especially as it omits day trips under 100 miles. This inadequacy leads to a lack of understanding of the tourism economy of several shore counties and its vulnerability in the event of an oil spill beaching in these areas.

Raised by: State of New Jersey
Cape May County Planning Board, New Jersey
Ocean County Board of Chosen Freeholder, New Jersey
Citizens Energy Coalition of New Jersey

Response: The environmental statement recognizes the deficiencies in the data it presents. The FES has been expanded to further clarify the data limitations. In addition, data provided by Cape May County relative to tourism in the southern New Jersey shore counties has been included in the FES (Section II.G.1.e.). The discussion of impacts on recreation and tourism which may result from the proposed action takes into account the importance of tourism to the total economy of these counties. The section on economic impacts has been expanded to include additional discussion of the economies of the southern New Jersey shore counties which may not have been totally accurately portrayed in the Harris economic model because of its limitations.

ISSUE: #17 In its discussion of air quality impacts, the DES does not give adequate consideration to the possibility of air pollution exceeding the levels specified for non-significant deterioration of air quality.

Raised by:
State of New Jersey
State of New York
Cape May County Planning Board, New Jersey
Sierra Club, Northeast Region
Natural Resources Defense Council, Inc.
Committee Against Oilports on the Bayshore (Middletown, New Jersey)
American Lung Association of Southern New Jersey
Citizens Energy Coalition of New Jersey
Ban-the-Tank-Coalition (Jersey City, New Jersey)

Response: The environmental impact statement discusses the emissions and levels of emissions which might result from OCS-related activities. It also addresses existing air quality and potential changes in various types of localities as a result of specific OCS-related activities, and points out that these potential impacts will be determined by what the air pollution standards are and how they are enforced by the appropriate jurisdictions having control over facility siting and air pollution regulation.

ISSUE: #18 The impacts of normal sediment movement in the Mid-Atlantic area and the potential stresses on pipeline emplacement is not fully discussed in the DES.

Raised by: State of Delaware

Response: Section III.B.3. contains an analysis of the impact of sediment in the Mid-Atlantic as it may affect pipelines. It is recognized as a problem which can only be mitigated by burial and surveillance. Appendix 4 contains a description of surveillance techniques. The special stipulation requiring burial of pipelines will help to mitigate this potential hazard.

ISSUE: #19 The FES should include more information comparing conditions in the North Sea with those in the Mid-Atlantic.

Raised by: Environmental Protection Agency
Sierra Club, Northeast Region

Response: More information concerning operating conditions in the North Sea has been included in Section III.C.7.

ISSUE: #20 The DES discussion of undetonated ordnance on lease tracts is inadequate; survey requirements, ordnance detection, and use of special stipulations are not adequately discussed.

Raised by: Environmental Protection Agency
State of New York
Ocean County Board of Chosen Freeholders, New Jersey

Response: In Chapter IV, a new special stipulation dealing with ordnance detection has been added (Stipulation #8) for the seven tracts that have undetonated ordnances.

ISSUE: #21 The DES treatment of military activities and OCS operations conflicts is inadequate.

Raised by: State of Delaware
State of New York

Response: Many of the military operations conducted on or in the Mid-Atlantic OCS are of a classified nature and therefore are not described in the FES. Department of the Interior and Department of Defense officials have met to discuss and resolve any conflicts between military operations and oil and gas activities on the Mid-Atlantic OCS, and will continue to maintain such coordination while any OCS operations are active in this area.

ISSUE: #22 The cumulative and secondary/indirect impacts of all resources and activities relating to this proposal should be more completely discussed and analyzed in the FES.

Raised by:
Environmental Protection Agency
National Marine Fisheries Service
U.S. Fish and Wildlife Service
U.S. Coast Guard
State of New York
State of New Jersey
Ocean County Board of Chosen Freeholders, New Jersey
Middlesex County Planning Board, New Jersey
Borough of Lavallette, New Jersey
Rutgers University, Marine Sciences Center
Natural Resources Defense Council, Inc.
Citizens Energy Coalition of New Jersey
National Coalition for Marine Conservation, Inc.
John H. McDermitt (Paterson, New Jersey)

Response: Because the location and amounts of any oil and gas resources which may exist in the Mid-Atlantic cannot be determined with any certainty prior to exploratory drilling, it is very difficult to quantify impacts which may result from the proposed action. Every effort has been made to do so, however. In discussing cumulative and secondary impacts, the difficulties are compounded. However, the FES has been revised to include more analysis of the cumulative impacts of this proposed action and any dredging which may result, as well as the cumulative impacts of this proposal and ocean dumping and additional Mid-Atlantic sales. (Section III.H.) The section on land use impacts (Section III.D.1.d.) has been reorganized to indicate direct and secondary impacts. The section on economic impacts and the section on impacts to population and infrastructure which follows from the economic impact analysis, (Sections III.D.1.b. and c.), are, because of the nature of the economic analysis, concerned with both primary and secondary impacts. The economic model, which was used as tool in discussing potential economic impacts of the proposed sale, used as inputs the primary impacts expected as a result of the proposal. The results of the analysis are both primary and secondary impacts which might be expected as a result of the proposed sale.

ISSUE: #23 **The FES should discuss the cumulative impacts of all lease sales in the Atlantic area, in addition to those of the Mid-Atlantic region.**

Raised by:
State of New York
Commonwealth of Virginia
Suffolk County, New York, County Executive (John V. N. Klein)
League of Legislative Conservation, New Jersey
John Pershing (Washington, D.C.)

Response: This EIS addresses the cumulative impacts of this proposed lease sale in the Mid-Atlantic OCS as the first proposed sale that could commit this area to further development. Other proposed sales in the Atlantic area, as in all other OCS areas, will be analyzed by separate site-specific EIS's, pursuant to NEPA and CEQ requirements. See Section III.H. for further discussion of the possible cumulative impacts related to this proposal.

ISSUE: #24 The EIS should provide a cost/benefit analysis concerning costs of extracting OCS oil and gas in the Mid-Atlantic and effects on the overall environment, particularly on recreation/tourism effects.

Raised by:
State of New York
State of Maryland
Natural Resources Defense Council, Inc.
Long Island Association of Commerce and Industry
Citizens Energy Coalition of New Jersey
Watch Our Waterways/Save Our Seashores

Response: The purpose for preparing an EIS is principally to provide the decisionmaker and the public with the environmental consequences associated with the proposed action, and to place the proposed action in a functional and socioeconomic context. It is left to the decisionmaker to compare and balance economic, technical, and alternative considerations and ultimately to decide the issue. To engage in formal economic cost/benefit analysis in the EIS itself would tend to obscure environmental analysis by transforming the statement into an overall decision making document centered around economic considerations and having a program justification focus. A separate overall decision making document, a Program Decision Option Document (PDOD), is prepared to provide the Secretary of the Interior with all aspects to be considered concerning this proposed lease sale.

ISSUES CONCERNING MITIGATING MEASURES

ISSUE: #1 The mitigating measures for this Mid-Atlantic OCS Sale No. 40 proposal do not indicate specific commitments that will protect the environment.

Raised by:
Cape May County Planning Board, New Jersey
Natural Resources Defense Council, Inc.
National Coalition for Marine Conservation, Inc.
Rutgers University Marine Sciences Center

Response: The U.S. Geological Survey will require that the best practical operating equipment and techniques be employed in exploring and developing the Mid-Atlantic OCS. This will be assured through the OCS Orders specifically designed for the Mid-Atlantic area, through the review by State and Federal officials of plans of explorations and development, and through a comprehensive inspection program. Early exploratory drilling operations will be inspected on a continuous basis. Unsafe operations will lead to an enforced shutdown (suspension) of operations until corrective actions are taken. Should early operations indicate that additional requirements are necessary, Notices to Lessees and Operators, mandating requirements will be issued on a case-by-case basis.

The statutes and regulations of the appropriate Federal agencies dealing with the OCS will be maintained to assure that all OCS-related activities are in compliance. Each Federal agency is responsible for coordinating with others regarding OCS matters.

ISSUE: #2 **The USGS Mid-Atlantic OCS Operating Orders should be finalized and included in the FES**

Raised by: Environmental Protection Agency

Response: Those Mid-Atlantic Operating Orders pertaining to the exploration phase (see Appendix 11 of this FES) will be finalized prior to any lease sale in this area. Mid-Atlantic Operating Orders pertaining to development operations will be finalized prior to the approval of any development plans for this Mid-Atlantic OCS area. Additional Operating Orders will be prepared, reviewed, and finalized as required, for example, if subsea completion systems should be approved for uses in the Mid-Atlantic OCS.

It should be recognized that each OCS Order covers a specific function, and is not necessarily required at the time of a lease sale. For example, Order No. 8 which covers production platforms and structures is not needed immediately at the time of a lease sale, since production is not anticipated until at least three years after a sale. However, it is not unreasonable to expect those OCS Orders relating to drilling operations to be finalized at or near the time of the lease sale, as in the case of Order Nos.1-5, 7 and 12 for this Proposed Lease Sale No. 40.

ISSUE: #3 The development plans prepared by the lessees should be subject to further separate environmental assessment, at which time more information on the exact location and quantities of resources is known, and the required offshore and onshore facilities can be more specifically defined and impacts assessed.

Raised by:
Environmental Protection Agency
Federal Energy Administration
State of New York
State of Maryland
State of Delaware
Atlantic County Board of Chosen Freeholders, New Jersey
Energy Action Committee, Washington, D. C.
Natural Resources Defense Council, Inc.
John Pershing (Washington, D. C.)

Response: The USGS prepares an environmental assessment and/or an EIS on any or all development plans submitted by lessees after leasing has occurred. The Department is investigating various modifications of OCS environmental analysis processes, including a dual EIS system, to undertake additional environmental analysis after development plans have been submitted by industry. Also see the response to the previous issue.

ISSUE: #4 A compensation fund mechanism should be established to assist States, counties and localities adjacent to lease areas in their planning, funding, and furnishing of support infrastructure for OCS activities.

Raised by:
State of Maryland
Commonwealth of Virginia
State of Delaware
Cape May County Planning Board, New Jersey
Cumberland County Planning Board, New Jersey
Monmouth County Environmental Council, New Jersey
Joseph F. Bradway, Jr., Mayor, Atlantic City, New Jersey
Charles Guhr, Mayor, Wildwood Crest, New Jersey
League of Women Voters of Delaware
Richard H. Demmy, UGI Corp., Valley Forge, Pennsylvania

Response: The establishment of any compensation fund program to assist States, counties and localities is beyond the authority of the OCS Lands Act and the Secretary of the Interior. However, several legislative proposals have been introduced in Congress which address this issue in various forms. The Administration has also proposed a bill, which provides guaranteed loans and planning grants regarding energy-related proposals. This proposed bill is designed to meet the financial problem of front-end expenses encountered by States and their counties and municipalities. See Section VIII.B.5. for more discussion.

The Land and Water Conservation Fund is one fund mechanism that is presently being partially funded by OCS revenues for the purposes of providing funds to States and to counties and localities through the States for recreational development. This Fund began disbursing monies to the States in 1965, and OCS revenues were included in the Fund beginning in 1969. In FY 1975, 82.4% of the $3,000,000,000 Fund was from OCS revenues.

ISSUE: #5 The pipeline stipulations are weakened seriously by the phrase "where technically and economically feasible."

Rasied by" Natural Resources Defense Council, Inc.
State of Delaware
Sierra Club, Northeast Region

Response: The Department of the Interior is committed to the concept of requiring burial of all pipelines which may be required as a result of the proposed sale, including flow lines. The Department is also committed to the concept of requiring transport of oil via pipeline, rather than allowing tanker transport. These stipulations were developed in recognition of the potential impacts which could result because of the extensive use of heavy trawling gear by commercial fishermen, heavy ship traffic and accompanying potential impacts from dragging anchors, as well as the potential problems associated with sediment transport in the Mid-Atlantic OCS. However, in order to be realistic, these stipulations are phrased to take into account that there may be situations where pipeline burial or use of pipelines are not feasible.

ISSUE: #6 The Department of the Interior must insure inspection, monitoring, and aerial surveillance of pipelines to detect and tract oil spills.

Raised by: Environmental Protection Agency
State of Maryland
James J. Howard (U.S. House of Representatives, New Jersey)

Response: In accordance with OCS Operating Orders and inspection procedures the USGS will insure that adequate inspection, monitoring, and aerial surveillance of pipelines will be made in the Mid-Atlantic OCS.

ISSUE: #7 The FES should discuss the effectiveness of oil spill containment equipment and the use of the best technology available offshore and nearshore in the Mid-Atlantic.

Raised by:
Cape May County Planning Board, New Jersey
Environmental Protection Agency
State of New York
State of Maryland
Charles Guhr, Mayor, Wildwood Crest, New Jersey
Guy Muziani, Mayor, Wildwood, New Jersey
Joseph F. Bradway, Jr., Mayor, Atlantic City, New Jersey
Joseph J. Polillo, Chelsea Heights Civic Association
New York City Environmental Protection Administration
Natural Resources Defense Council, Inc.
National Wildlife Federation
National Coalition for Marine Conservation, Inc.
Sierra Club, Northeast Region
Water Resources Association of the Delaware River Basin

Response: Section IV.C. of the FES has been revised to include an analysis of the effectiveness of oil spill containment and clean up equipment. However, it is not possible to predict what amount or what percentage of a hypothetical spill may be recovered. This section indicates presently available equipment in the Mid-Atlantic area. In addition, a new special stipulation has been developed (Stipulation #9) which augments OCS Order No. 7, outlining required oil spill containment and cleanup equipment and procedures.

ISSUE: #8 Oil Spill containment procedures and contingency plans should be developed prior to the commencment of drilling activities and best technology must be used.

Raised by:
Environmental Protection Agency
State of New York
Charles Guhr, Mayor, Wildwood Crest, New Jersey
Guy F. Muziani, Mayor, Wildwood, New Jersey
George E. Tompkins, Mayor, Seaside Heights, New Jersey
Borough of Lavallette, New Jersey
Natural Resources Defense Council, Inc.
Sierra Club, Northeast Region
National Wildlife Federation
National Coalition for Marine Conservation, Inc.

Response: The USGS Mid-Atlantic OCS Orders No. 7, 8, and 9 will require the lessee to maintain standby pollution control equipment which is the most effective available, resulting from the current state of pollution control and removal research and development efforts, and which can be depolyed immediately upon notification that a spill has occurred.

Part of the development plan submitted by the lessees to the USGS is their oil spill contingency plan. The plan must outline the initiative corrective action that will be taken to control and remove any pollution that occurs. Standby pollution control equipment and materials shall be maintained by or shall be available to each operator at an offshore or onshore location. This equipment shall include containment booms, skimming apparatus, cleanup materials and chemical agents. The chemicals will not be used without prior approval of the USGS.

ISSUE: #9 A comprehensive oil spill liability fund should be established to cover all environmental and economic losses and damages resulting from OCS oil spills.

Raised by:
State of New Jersey
State of Delaware
State of New York
State of Maryland
James D. Howard (U.S. House of Representatives, New Jersey)
William Hughes (U.S. House of Representatives, New Jersey)
James R. Hurley, New Jersey State Representative
Herman H. Holloway, Sr., Delaware State Senator
Charles D. Worthington, County Executive, Atlantic County, New Jersey
Monmouth County Environmental Council, New Jersey
Cape May County Planning Board, New Jersey
Natural Resources Defense Council, Inc.
Borough of Lavallette, New Jersey
John A. Rogge, Mayor, Brigantine, New Jersey
Atlantic County Board of Chosen Freeholders, New Jersey
Guy F. Muziani, Mayor, Wildwood, New Jersey
Charles Guhr, Mayor, Wildwood Crest, New Jersey
Angelo T. Errichetii, Mayor, Camden, New Jersey
Joseph F. Bradway, Jr., Mayor, Atlantic City, New Jersey
Charles Goodman, Mayor, Township of Long Beach, Beach Haven, New Jersey
New York City Environmental Protection Administration
Wilderness Society
Greater Salisbury Committee, Inc. (Salisbury, Maryland)
New Jersey Sportsmen-Industry Conservation Council
Lakeland Economic Area & Development Council (Rockaway, New Jersey)
Cape May County Chamber of Commerce, New Jersey
League of Women Voters of Delaware
Vincent McMahon (Villas, New Jersey)

Response: The establishment of a liability fund program to assist States, counties, localities, local businesses or private citizens is presently beyond the authority of the Secretary of the Interior. The Department does not have the regulatory power to establish such a fund in any form. Various bills have been introduced in Congress to establish liability funds in various forms. The Administration has proposed a bill, H.R. 2162 and S. 2162, which would provide compensation for oil spills from other sources in addition to OCS sources. This proposed bill sets up procedures by which a quick no fault settlement system would be established; the bill also carefully specifies eligible claimants and recoverable damages allowed. See Section VIII.B.6. for more discussion of other legislative proposals that have been introduced to cover this issue.

ISSUE
#9
(cont.)

The National Oil and Hazardous Substances Pollution Contingency Plan has a funding mechanism to compensate, based upon specific criteria, for oil spill damages incurred. In addition, compensation may be achieved through civil court actions.

ISSUE: #10 Coastal States adjoining the OCS lease sale areas should share in the Federal OCS revenues.

Raised by:
State of New Jersey
State of New York
William Hughes (U.S. House of Representatives, New Jersey)
Cape May County Planning Board, New Jersey
Atlantic County Board of Chosen Freeholders, New Jersey
Frank Dodd, President, New Jersey State Senate
Joseph F. Bradway, Jr., Mayor, Atlantic City, New Jersey
Charles D. Worthington, County Executive, Atlantic County, New Jersey
John A. Rogge, Mayor, Brigantine, New Jersey
Angelo L. Errichetti, Mayor, Camden, New Jersey
Charles Guhr, Mayor, Wildwood Crest, New Jersey
Lakewood Economic Area & Development Council (Rockaway, New Jersey)
Wilderness Society
Richard Demmy, UGI Corps, Valley Forge, Pennsylvania
Cape May County Chamber of Commerce, New Jersey
Steven J. Batzer (Harland, Inc., New Jersey)

Response: Commitments regarding revenue sharing require legislative decisions that are beyond the scope of this EIS to resolve. The Department of the Interior does not have the authority to allow the sharing of OCS-derived funds. Congress presently is considering various pieces of legislation regarding this concept. See Section VIII.B.5. for more discussion on this issue.

ISSUE: #11 The DES does not consider or propose a deletion of tracts located in ship navigation traffic lanes or heavily trafficked areas. The FES should consider deletion of the tracts or suggest that traffic routes be altered.

Raised by:
Environmental Protection Agency
Natural Resources Defense Council, Inc.
Sierra Club, Northeast Region
Watch Our Waterways/Save our Seashores
Robert W. Welsh, Jr. (Columbia Gas System Service Corporation)

Response: The U.S. Army Corps of Engineers has the authority to prohibit the placement of structures if they are determined to represent an interference with navigation. The Coast Guard, on the other hand, is the agency responsible for designating traffic lanes. (It should be noted, that the "designated" traffic lanes in the Mid-Atlantic are not official traffic lanes, as they have not been established through the procedures set forth in the Ports and Waterways Safety Act of 1972 (33 U.S.C. 1221-1227, P.L. 92-340)). In recognition of the heavy use of the designated lanes, the Corps of Engineers routinely consults the Coast Guard when making decisions as to whether to grant permits for placement of structures on the OCS in these traffic lanes. Therefore, both the authority and regulatory mechanism exists to assure that no structures are located in areas where they have been determined to present a hazard to navigation. The OCS Lands Act specifically retains the U. S. Corps of Engineers' authority over this matter.

Based on past practice of the Corps of Engineers, the Department does not anticipate that drilling structures will be allowed in traffic lanes. However, the five tracts which are partially within the Hudson-Ambrose lane have been proposed for leasing in recognition that directional drilling would allow drilling in these tracts despite the prohibition of structures in the traffic lanes themselves.

ISSUE: #12 The Department of the Interior should have a stipulation to require mandatory unitization of exploration in the Mid-Atlantic OCS.

Raised by: State of New Jersey

Response: The Department of the Interior has the regulatory powers to require unitization of producing fields, as discussed in Section IV.F. of this FES. Mandatory unitization of exploratory activities could deter rapid, efficient exploration to determine the quantity and quality of reserves in the Mid-Atlantic OCS which would not be in the public interest to efficiently develop domestic energy resources to achieve energy self-sufficiency. Depending upon the location and spatial distribution of tracts chosen to actually be explored and developed, mandatory unitization could be prohibitively expensive and technologically not feasible, and could deter activities. Economic factors generally serve quite effectively to minimize construction of offshore facilities. Unitization will be used where possible under the OCS Lands Act in the interest of conservation.

ISSUE: #13 The benefits of unitization and the extent to which it has been used elsewhere should be discussed.

Raised by: Federal Energy Administration

Response: Unitization can result in efficiencies of OCS oil and gas development. It can reduce duplication of effort, minimize the number of offshore facilities required to achieve efficient means of exploration and rates of oil and gas production. More discussion is provided in Section VIII.J. of the Final OCS Programmatic EIS. Also see response #12.

ISSUE: #14 There should be a stipulation requiring stiff penalties for companies which fail to explore their leases promptly; companies should not be allowed to delay exploration and development once lease rights have been granted.

Raised by: State of New Jersey
Energy Action Committee, Washington, D.C.

Response: The OCS Lands Act provides for penalties for non-compliance with lease requirements, including diligence requirements, under Sections 5(b)(1) and 5(b)(1). See Section IV.A. and Appendix 11 (proposed OCS Order #14) of this FES.

ISSUE: #15 A stipulation and/or specific criteria should be prepared to prohibit or suspend drilling exploration or production, or to cancel any lease at any time, if adverse impacts or continued activity would reach a danger point or threaten serious or irreparable harm or damage to life, property, mineral resources, or the environment.

Raised by: State of Maryland
Cape May County Planning Board, New Jersey
Wilderness Society

Response: The OCS Operating regulations, particularly 30 CFR 250.12(c) authorizes the USGS to suspend any operation, including production, which threatens immediate, serious or irreparable harm or damage to life, including aquatic life, to property, to the lease deposits, to other valuable mineral deposits or to the environment. The USGS pursuant to 30 CFR 250.12(b), may also prescribe or approve departures from the OCS Orders, other orders, or rules issued when such departures are seen necessary for the proper control of a well, conservation of natural resources, protection of aquatic life, protection of human health and safety, property, or the environment.

ISSUE: #16 **The FES should discuss a lease stipulation concerning the curtailment of operations in bad weather when spill containment technology would likely not contain and control oil spills due to weather and sea state.**

Raised by: State of Maryland

Response: As discussed in Section III.A.2. of the FES, an analysis of drilling histories of over 700 wells in the North Sea shows that while bad weather could be a factor, it has never caused a significant pollution incident in the North Sea. It might also be noted in Section III.A.3. that as the intensity of the weather increases so does its ability to break up or dissipate oil that is floating on the surface. This dissipation combined with the distance from shore of the tracts of this Mid-Atlantic proposal would actually be a strong factor in preventing oil from reaching shore. Therefore, while bad weather was carefully considered, it was not felt necessary to develop a special stipulation to curtail operations or regulate them as a function of sea state specifically. Section III.A.4. discusses the oil spill frequencies, probabilities, and trajectories analyzed for this proposed lease sale area.

The OCS Operating Orders and 30 CFR 250 regulations allow suspension should it be necessary. Title 30 CFR 250.12(c) provides that the USGS Supervisor is authorized to suspend any operation, including production, which in his judgment threatens immediate serious, or irreparable harm or damage to life, including aquatic life, to property, to the leased deposits or to the environment. The curtailment of operations in bad weather would fall within the authority of this section of the regulations.

ISSUE: #17 The FES should discuss a stipulation requiring OCS drilling in the non-summer, low-recreation season to avoid possible oil spill impacts on the summer tourist economy.

Raised by: Leo Sterenberg, Cape May County Chamber of Commerce New Jersey

Response: A careful consideration of drilling risks as a function of season balanced together with a spill's possible impact on the tourist economy, biological impacts, and other resource values of concern in this Mid-Atlantic area, plus the additional factors of exploration and development activities' postponement and the added expense of storage during the inactive summer season, indicates that this type of stipulation is not warranted for this proposal. The distance from shore of the closest tracts (54 miles), together with the analysis of oil spill trajectories (Section III.A.4.), indicates that the probabilities of oil reaching shore and impacting recreation and tourism economies are relatively minimal in comparison to the overall costs and lack of benefits of requiring such a stipulation.

ISSUES CONCERNING ALTERNATIVES TO THIS PROPOSAL, EXCLUDING CERTAIN PROCEDURAL ALTERNATIVES

ISSUE: #1 The DES treatment of alternatives to the proposed action, especially the alternative of energy conservation, is wholly inadequate.

Raised by:
State of New Jersey
New York State Department of Law
Natural Resources Defense Council, Inc.

Response: As indicated in the DES, the description of energy alternatives to the proposed action is summarized from a study funded in part by the Department of the Interior, Energy Alternatives: A Comparative Analysis. This document provides detailed analyses of energy alternatives and their environmental impacts. The summary of the alternative of energy conservation has been revised in the FES. The FES discussion of energy alternatives also utilizes the undiscovered recoverable resource estimates of 0.4 to 1.4 billion barrels of oil and 2.6 to 9.4 trillion cubic feet of gas in discussion substitute energy sources. The Final OCS Programmatic EIS also contains a discussion of energy alternatives to the OCS accelerated gas leasing program in Section VIII.A-D and G.-L.

ISSUE: #2 The BLM Baseline Environmental Studies Program for the Mid-Atlantic area should be completed before the sale is held in order to provide environmental data for the impact analysis and to incorporate changes or modifications that may be required for leases and resulting OCS operations. The DES does not indicate where the baseline studies will fill acknowledged data gaps, nor is there a clear relationship of the Studies Program and the OCS leasing program.

Raised by:
U.S. Coast Guard
Energy Research and Development Administration
State of New York
State of Maryland
State of Rhode Island, Governor's OCS Advisory Task Force
Office of the Supervisor, Islip, New York
Natural Resources Defense Council, Inc.
National Wildlife Federation
League for Conservation Legislation (New Jersey)
Freeholders Association of Monmouth County, New Jersey
Wilderness Society
Watch Our Waterways/Save our Seashores
George E. Tompkins, Mayor, Seaside Heights, New Jersey
Guy F. Muziani, Mayor, Wildwood, New Jersey

Response: The environmental studies program has been initiated in anticipation of the discovery of oil and gas in the Baltimore Canyon Trough and insuing oil and gas operations. The program will complete its first year in the late summer of 1976, and preliminary information is now beginning to become available, and is reflected in parts of the Sections II.A. and F. discussion of this FES. The baseline studies data and analyses will be available throughout the exploratory phases, continuing through the development phase into production. Monitoring studies will be continued upon completion of the baseline studies in late 1976. Although not designed for predictive capability, all studies data will be available to use as a basis for additional stipulations that may be required on leases when it is deemed advisable for environmental reasons. See Section I.D.2. of this FES for a complete discussion of the Environmental Studies Program. Also see Section VIII.B.2. of this FES for discussion of this alternative.

ISSUE: #3 The Coastal Zone Management Plans for each of the adjacent Mid-Atlantic States should be implemented before this lease sale is held.

Raised by:
State of New York
Office of the Supervisor, Islip, New York
Atlantic County Citizens Council on Environment, New Jersey
Natural Resources Defense Council, Inc.
National Wildlife Federation
National Parks and Conservation Association
Wilderness Society
American Lung Association of Southern New Jersey
Eneas D. Kane (Standard Oil Company of California)
Steven J. Batzer (Harland, Inc., New Jersey)

Response: The Department of the Interior has taken the position that potential OCS leasing activities, prior to the development of coastal zone management plans, would not place adjacent States in an untenable position in planning for potential onshore impacts. The Coastal Zone Management Act of 1972 presently has the provision that each coastal State should have a plan implemented by the end of 1977. However, Congress is presently discussing a possible extension of this timeframe to 1978. Regarding the timing of the Mid-Atlantic States' coastal plans in relation to this proposed sale No. 40, the development activities would not commence until at least three years after active exploratory drilling has started. This timeframe, as presently proposed, would indicate that development activities would probably not commence until sometime in 1979 at the earliest, and most certainly not prior to State review and approval of all lessees' development plans. Section VIII.B.1. discusses this alternative.

ISSUES CONCERNING LEASING PROCEDURES AND MANAGEMENT OF OCS OIL AND GAS OPERATIONS PERTAINING SPECIFICALLY TO THIS PROPOSED SALE

ISSUE: #1 More extensive Federal-State cooperation and coordination is needed in the OCS lease sale decisionmaking and planning process.

Raised by:
State of New Jersey
State of New York
State of Delaware
State of Rhode Island, Governor's OCS Advisory Task Force
New York City Environmental Protection Administration
Frank Dodd, President, New Jersey State Senate
Atlantic County Citizens Council on Environment
New Jersey State Beach Erosion Commission
Watch Our Waterways/Save Our Seashores

Response: The Department supports and encourages the consultation and coordination with appropriate State and local authorities in all aspects of the OCS oil and gas leasing program. With regard to this proposed lease sale No. 40 in the Mid-Atlantic, the Department undertook an extensive effort to inform officials and the public concerning this proposal. The Department intends to continue to follow this practice in the future in the Mid-Atlantic States and all other areas as well.

Recognizing the importance of coastal State involvement in the planning phase of the OCS leasing program, the Department established, in 1974, an OCS Research Management Advisory Board. In 1975, the Board's functions were separated. An OCS Advisory Board and an OCS Environmental Studies Advisory Committee were formed. All coastal States have representatives as well as various Federal agency representatives on these Boards. The OCS Advisory Board is a forum for keeping the States abreast of Federal OCS program plans and activities while encouraging them to offer comments and recommendations on OCS policy decisions. The OCS Environmental Studies Advisory Committee is designed to enhance Federal-State coordination, at the technical scientific level, of research and environmental studies needs concerning the OCS.

In addition, throughout the planning of the Mid-Atlantic OCS lease sale No. 40 proposal, the BLM contacted many of the State agency representatives for information pertaining to the various resources of the area. The

ISSUE:
#1 (cont.)

Governors of each of the States and their representatives were notified at the time a Call for Nominations and Comments was issued. Each State was invited to comment on this issue, and was notified by the OCS Manager of the dates of meetings discussing tract selection and invited to attend. Industry nominations maps were provided to the State representatives. Throughout the tentative tract selection process, the States were kept informed of any significant changes that might be made prior to the formal announcement of the tentative tract selection list. The States were participants in the formal meetings between BLM, USGS, and the Fish and Wildlife Service regarding this proposal.

Throughout the preparation of the draft environmental statement, the State agencies were contacted by the BLM personnel regarding input to the description and analyses of the proposal. Prior to the formal review of the draft environmental statement in the Washington Offices of the Department of the Interior, the preliminary, unapproved draft EIS sections were distributed to each of the States' representatives as they were completed, whereupon the States were given about two weeks for review and comment. BLM personnel from the OCS Office arranged visits to the States to receive and discuss the States' review comments. These steps all are in addition to the previously established NEPA procedures regarding comment on the Draft Statement upon its availability to CEQ and the general public, and speaking at the public hearing. The public hearing for this proposal was held in Atlantic City, New Jersey, from January 27-30, 1976, where 137 persons participated. The comment period for the Draft Environmental Statement was open through February 17, 1976.

ISSUE: #2 State, county, and local statutes, regulations, and zoning and permitting powers and authorities must not be bypassed or overridden in the planning and siting of onshore OCS-related facilities in this Mid-Atlantic region.

Raised by:
- Cape May County Planning Board, New Jersey
- Middlesex County Planning Board, New Jersey
- Cumberland County Planning Board, New Jersey
- Monmouth County Environmental Council, New Jersey
- Atlantic County Board of Chosen Freeholders, New Jersey
- James J. Howard (U.S. House of Representatives, New Jersey)
- Frank Dodd, President, New Jersey State Senate
- Herbert J. Buehler, New Jersey State Senator
- Charles D. Worthington, County Executive, Atlantic County, N.J.
- Angelo J. Errichetti, Mayor, Camden, New Jersey
- Borough of Keyport, New Jersey
- Borough of Lavallette, New Jersey
- Rutgers University Marine Science Center
- Committee Against Oilports on the Bayshore (Middletown, N.J.)
- Citizens Energy Coalition of New Jersey
- Ban-the-Tank-Coalition, Jersey City, New Jersey
- John H. McDermitt (Paterson, New Jersey)
- Vincent McMahon (Villas, New Jersey)

Response: The Department of the Interior has no authority by statute regarding the planning and siting of onshore OCS-related facilities. The States, counties, and local municipalities are responsible for enforcing their own statutes, regulations, and zoning and permitting powers. However, in accordance with 30 CFR Part 250.34, information contained in the development plans prepared by the lessees will be provided to the adjacent States. This will provide the States with more detail regarding offshore resources and onshore facilities that will be needed in order that the States can better plan and coordinate the industry needs with all their State, county, and local authorities.

ISSUE: #3 There should be a guarantee, by rule or stipulation, that all or a majority of the oil and gas production resulting from this lease sale proposal be sold and marketed domestically, particularly to the Mid-Atlantic States area.

Raised by:
State of New York
Joseph F. Bradway, Jr., Mayor, Atlantic City, New Jersey
Atlantic County Board of Chosen Freeholders, New Jersey
William J. Miners (New Jersey Gas Association)
William A. Gemmel (South Jersey Gas Company)

Response: Such a guarantee is beyond the scope of the provisions of the OCS Lands Act, and beyond the authority of the Secretary of the Interior. OCS oil and gas as a resource of the entire nation to be made available to all people cannot be marketed in only one portion of the United States, such as the Mid-Atlantic region, to the exclusion of other portions of the nation. Offshore gas supplies delivered to pipeline systems are under the authority of the Federal Power Commission, who allocates supplies to markets under existing statutes and regulations. Any attempted provisions to control the marketing of offshore oil and/or gas is in violation of the Sherman Anti-Trust Act (15 U.S.C. 1-7; 26 Stat. 209; 69 Stat. 282; 88 Stat. 1708).

ISSUES CONCERNING OVERALL DEPARTMENTAL POLICY ON OCS LEASING PROCEDURES AND MANAGEMENT OF OCS OIL AND GAS OPERATIONS

ISSUE: #1 The EIS should discuss possible changes and variations in the OCS lease bidding process to improve those presently used.

Raised by:
State of New Jersey
Atlantic County Citizens Council on Environment, New Jersey
Natural Resources Defense Council, Inc.
Energy Action Committee, Washington, D.C.
Richard H. Demmy, UGI Corp., Valley Forge, Pennsylvania
E.J.Langhetee, Jr. (Louisiana Land and Exploration Company)

Response: Of programwide significance, this issue is discussed in the Final OCS Programmatic EIS in Section VIII. Changes such as (1) royalty bidding with fixed bonus, (2) net profit sharing, and (3) deferred bonuses are presently under consideration by the Department of the Interior, and by Congress which is presently proposing various changes in the OCS Lands Act.

ISSUE: #2 The exploration and development phases should be separated and exploration and development plans should be prepared, assessed, and approved before drilling rights are sold.

Raised by:
State of New York
State of Delaware
State of Maryland
State of New Jersey
William Hughes (U.S. House of Representatives, New Jersey)
Middlesex County Planning Board, New Jersey
Cape May County Planning Board, New Jersey
Charles D. Worthington, County Executive, Atlantic County, New Jersey
Atlantic County Board of Chosen Freeholders, New Jersey
Committee Against Oilports on the Bayshore (Middletown, New Jersey
Long Island Environmental Council, New York
John H. McDermitt (Paterson, New Jersey)
Edwin Kirk (Philadelphia, Pennsylvania)

Response: While the separation of exploration from development is not possible under the OCS Lands Act of 1953, several measures have been introduced in Congress that will directly or effectively amend the Act to achieve such a separation. The Department is investigating various modifications available to it under existing law including a dual EIS system which through separate environmental analyses would separate the exploration and development phases. The Final OCS Programmatic EIS considers an alternative in Section VIII regarding the separation of exploration and development.

Only after leases are bid upon by the industry, and have been accepted by the Department of the Interior, can exploratory drilling activity plans be prepared by the lessees. It is impossible to formulate meaningful development plans prior to exploratory activities to discover the location, quantity and type (oil and/or gas) of the resource.

ISSUE: The exploration phase should be conducted by the Federal
#3 Government.

Raised by:
- State of New York
- State of New Jersey
- State of Maryland
- Atlantic County Citizens Council on the Environment, New Jersey
- Leagur for Conservation Legislation (New Jersey)
- Committee for a Better Environment (New Jersey)
- Citizens Energy Coalition of New Jersey
- John Pershing (Washington, D.C.)
- Energy Action Committee, Washington, D.C.

Response: Exploration by the Federal Government is discussed as an alternative in Section VIII of this FES.

ISSUE: #4 The stratigraphic test wells or research wells should be drilled directly into potential reservoirs to provide a maximum amount of information and data concerning the resources that may be discovered.

Raised by: State of New Jersey
State of New York

Response: The practice of requiring stratigraphic test holes to be drilled off-structure has come under criticism. The argument has been advanced that since these holes are intended to yield information about oil and gas, they should be drilled wherever they will yield the most information, and this may, in many cases, be on-structure. There is a sound counter-geological argument, however, that you can learn more geologically from drilling off-structure than you can from drilling on-structure. On-structure involves by definition a deformed area, and many geologists believe that you may, in fact, not get the full geologic picture of the area from drilling into the deformed area. Drilling on-structure may yield information on the actual presence of oil, on the odd chance that oil is discovered, but it may just as likely not yield a "show" of hydrocarbons. In the latter case, less would be learned by drilling on-structure than

There are a number of other reasons which have persuaded the Department, to date, to allow only off-structure stratigraphic test wells. First, drilling off-structure reduces the risk of a potential polluting accident. Second, the administrative burdens would be increased in the case of on-structure drilling in that (1) a more detailed environmental assessment would have to be prepared, (2) issues pertaining to the release of information dealing with hydrocarbon "shows" would have to be considered, and public release could have an effect on competitive bidding in a potential sale in the area tested, and (4) the Department would have to commit a substantially increased personnel effort and additional funds that would be necessary to work out additional drilling requirements, including additional safety equipment requirements, as in the case of off-structure drilling.

At this time, the Department has determined that the balancing of pro factors and contra factors involved in stratigraphic drilling, as described above, favors a continuation of the Department's policy of allowing only off-structure stratigraphic test wells.

ISSUE: #5 The present accelerated OCS leasing procedures are not resulting in a fair market value being received by the Department of the Interior pursuant to the OCS Lands Act of 1953.

Raised by: State of New York
State of Delaware
Natural Resources Defense Council, Inc.
Energy Action Committee, Washington, D.C.
Citizens Energy Coalition of New Jersey

Response: Current Departmental practices and studies are designed to assure that the lease auction of OCS resources is competitive enough to insure receipt of fair market value. The Department has been using a Monte Carlo simulation model in the estimation of the value of tracts offered for lease. This simulation approach provides a more accurate representation of the uncertainties inherent in hydrocarbon estimation. Through the use of this model and improved bid evaluation system, the Department is in a position to more accurately assess whether the high bids received on tracts reflect fair market value. Since the inception of the Monte Carlo program in 1974, approximately 16 percent of the high bids received have been rejected. Here too, the proposed data disclosure regulations offer benefits in putting all bidders on equal terms regarding the offshore geologic data they possess.

Final regulations banning joint bidding among the largest oil companies were published in the Federal Register on October 1, 1975. All companies, including their subsidiaries, that produce more than 1.6 million barrels of oil and natural gas equivalent a day, will be banned from bidding jointly with each other. Companies had until October 20, 1975, to submit a statement on production which would be applicable for the bidding period November 1, 1975, through April 30, 1976. A list of bidders excluded from bidding together during the above period was published in the Federal Register on October 31, 1975.

The Department has analyzed alternative bidding methods available to it under the OCS Lands Act of 1953. Options were reviewed in the context of whether or not they achieved lower front end costs, assured payment of a fair return to the Government and ensured the maximum economic recovery of each reservoir. A test of the royalty bidding option took place in October 1974. Ten tracts were offered with eight being leased and the sale results have been analyzed. We are continuing to study the effect on resource recovery. In addition, three tracts in the recent California OCS lease sale were offered at a fixed royalty of 33 1/3 percent.

ISSUE: #6 The Department of the Interior has failed to provide that a lease may be terminated at any time if necessary to protect the environment.

Raised by: State of New York Department of Law
Natural Resources Defense Council, Inc.

Response: The Department has determined that (1) an OCS oil and gas lease must be issued for five years and as long thereafter as oil and gas may be produced from the area in paying quantities, pursuant to Sect. 8(b)(2) of the OCS Lands Act, and (2) an OCS oil and gas lease may be cancelled only upon the lessee's failure to comply with the provisions of the OCS Act, the regulations in force and effect at the time the lease is issued, and the lease itself, and not upon the occurrence of an event which does not involve the lessee's default, e.g., the discovery of previously unknown environmental dangers. Thus, the Department has concluded that the Secretary does not have the authority to include in the leases a termination clause permitting him to cancel a lease for unforeseen environmental hazards. The Department has, however, provided by regulation (30 CFR 250.12(c)) for the suspension of operations, including production, which threaten immediate, serious, or irreparable harm or damage to life, including aquatic life, to property, to lease deposits, to other valuable mineral deposits, or to the environment until such time as the responsible official determines that the threat or danger has terminated.

Moreover, the Secretary is given wide authority under section 5(a) of the OCS Lands Act to issue regulations in the interest of conservation of the natural resources of the OCS. He is specifically authorized to issue regulations for the suspension of operations in the interests of conservation. OCS leases provide that the leases are subject, *inter alia*, to regulations thereafter promulgated pursuant to section 5(a)(1) of the OCS Lands Act. Such leases would also be subject to any OCS operating orders which may be adopted to implement such regulations.

Thus, if, after lease issuance, environmental information should become available or new technology developed, Departmental regulations could be issued to require additional safeguards or new technology where such requirements are in the interest of conservation of the natural resources of the OCS.

ISSUE:
#6 (cont)

Where it is shown that a suspension would be in the interests of conservation of natural resources, there is no time limit set on the suspension, but that of reasonableness. A suspension for this purpose would, however, be limited to a suspension which gave promise of eventual development, and not a suspension which was, in effect, a termination.

ISSUE: #7 The Department of the Interior should retain the right to terminate or limit the exploration and/or development of tracts to prevent chronic or flagrant violations of operating orders and failure to control pollution, or failure to produce reserves at maximum efficient rates, including withholding of production.

Raised by:
State of New Jersey
State of Maryland
State of New York
Cape May County Planning Board, New Jersey
Atlantic County Board of Chosen Freeholders, New Jersey

Response: Cancellation of an OCS oil and gas lease is expressly provided in the OCS Lands Act. Section 5(b) of the Act states when a lease may be cancelled. The lease may be cancelled administratively under section 5(b)(1) when it is nonproducing, or by judicial action under 5(b)(2) when it is producing, when the owner of the lease "fails to comply with any of the provisions of this Act, or of the lease, or of the regulations issued under this Act and in force and effect on the date of issuance of the lease ...." This cancellation authority is explicitly tied to noncompliance by a lessee.

OCS operating orders implement Departmental regulations and flagrant violations of such orders would subject the lease to the cancellation provisions of the Act. (See 43 CFR 3306.2 and 3307.3-4.)

A continued failure to control pollution from known potential sources of pollution, which is subject to control under prevailing practices and technology would constitute a violation of OCS operating orders and regulations, and would subject the OCS lease to cancellation action pursuant to the OCS Lands Act.

The Department has provided by regulation (30 CFR 250.33(a) and (b), and 43 CFR 3307.3-4) for the diligent development of OCS leases. Should circumstances show that a lessee was not diligently producing reserves from his leasehold, that OCS lease would be subject to the cancellation provisions of the OCS Lands Act.

ISSUE: #8 A stipulation and/or specific criteria should be prepared to prohibit or suspend drilling exploration or production, or to cancel any lease at any time, if adverse impacts or continued activity would reach a danger point or threaten serious or irreparable harm or damage to life, property, mineral resources, or the environment.

Raised by: State of Maryland
Cape May County Planning Board, New Jersey
Wilderness Society

Response: The Department has provided for a suspension of an OCS oil and gas lease in the circumstances described in the above-captioned issue. Pursuant to 30 CFR 250.12(c), the responsible official may order a suspension of operations, including production, which threaten immediate, serious, or irreparable harm or damage to life, including aquatic life, to property, to lease deposits, to other valuable mineral deposits, or to the environment until such time as the responsible official determines that the threat or danger has terminated. The Department has determined that it does not have the authority to include in leases a termination clause permitting the Secretary to cancel a lease in the circumstances described above. (See earlier discussion of the issue entitled "The Department of the Interior has failed to provide that a lease may be terminated at any time if necessary to protect the environment.")

ISSUE: **Despite the NEPA process, it is felt that the decision to**
#9 **lease in the Mid-Atlantic OCS has already been made.**

Raised by: Frank Dodd, President, New Jersey State Senate

Response: Under the NEPA process, the DES, public hearing, and FES are steps in the decisionmaking process and not the decision to lease. The Secretary of the Interior has made no decision to hold the proposed sale and will not do so until he had reviewed the FES and the Program Decision Option Document (PDOD). The Secretary can not make a decision to hold the lease sale until a minimum of 30 days has passed after the availability of the FES. The PDOD provides the Secretary with a summary document on the various options and alternatives regarding the proposed lease sale including environmental, technologic, economic, and other considerations.

5. Federal Agencies

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

February 6, 1976

Mr. Frank A. Edwards
Assistant Director
 Minerals Management
Bureau of Land Management
U. S. Department of the Interior
Washington, D. C. 20240

Dear Mr. Edwards:

This is in reference to your draft environmental impact statement entitled "Proposed 1976 Outer Continental Shelf, Oil and Gas Lease Sale, Offshore the Mid-Atlantic States." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving thirteen copies of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosures Memos from: Mr. George P. Cressman, NWS
Mr. Lewis A. Pitt, EDS
Mr. Harris B. Stewart, AOML
Mr. William G. Gordon, NMFS

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE
Silver Spring, Md. 20910

RECEIVED
FEB ~~8~~ 9 1976
DIVISION OF [illegible]
ENVIRONMENTAL [illegible]

Date : JAN 13 1976

Reply to Attn. of: W16/GAF

To : Dr. William Aron
Director, Office of Ecology and Environmental Conservation, EE

From : George P. Cressman
Director, National Weather Service, W.

Subject: DEIS 7512.23 - DOI Proposed Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States OCS SALE NO. 40

We have reviewed the sections II-B, Meteorology and II-C, Physical Oceanography.

In reference to section II-B, the DEIS addresses fully the problems of storm surge, high waves, storm winds, and restricted visibility. Statistics generally come from Quayle, Thom and others in EDS. Comparison is made with conditions in Alaska and the North Sea with conclusions that conditions are less severe and do not bar present state of the art operations. Oil spill trajectory estimates are admittedly poor because of lack of knowledge of currents and oil spill movement relative to wind and current. The report ends up with the 3% estimate, a crude rule-of-thumb. This section appears adequate.

Section II-C appears to be complete, except for a few minor inconsistencies:

(1) Page 125, paragraph 2, line 1 -- should read late summer;

(2) Pages 129-131 -- discussion of the Gulf Stream is too general and fails to describe an important feature between longitudes 71-73°W;

(3) Page 136, bottom 4 lines -- phrase "overall cyclonic circulations" should be clarified. We believe that the writers intended to state that ". . . the slope water circulation is generally cyclonic . . . ."

We concur with the statement on ocean data needs on page 158. The Mid-Atlantic area is particularly deficient in ocean climatology at mid-and bottom depths. All interested agencies should endeavor to acquire measurements to fill the data void.

cc: MR

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL DATA SERVICE
Washington, D.C. 20235

January 15, 1976 Dx61/DLEC JAN 19 1976

TO: William Aron
Director, Office of Ecology and Environmental Conservation, EE

FROM: Lewis A. Pitt
Special Projects

SUBJECT: EDS Review of DEIS 7512.23 (DOI Proposed Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States OCS SALE NO. 40)

The EDS has reviewed the subject DEIS and offers the following comments:

General Comments

Most of the general oceanographic comments and conclusions in the environmental statement are based on the work of H.B. Bigelow of Yale University, which was completed over 40 years ago. Although his work is famous for its quality and completeness, it would still have been carried out with relatively unsophisticated instrumentation. Newer, more recent, and more comprehensive data should also be considered, especially STD type data, since this is an area of complex circulation. Microstructure will play an important role in contaminant dispersion and this can best be examined only with a continuous recording device such as an STD.

The discussions on salinity and temperature should have touched on the extent or frequency of variability from one year to the next. Some mention should also be made of how these variations, if any, may correlate with natural phenomena such as severe storms or unusual fresh water effluence.

Specific Comments

Volume 1, page 107, 2nd paragraph:

(1) This paragraph is misleading and inaccurate. The first 2 sentences say that most storms are either transcontinental or tropical, with the former occurring in the spring. Two paragraphs later it is stated that extratropical storms occur throughout the year, but mostly in winter. Since transcontinental storms are extratropical, this is contradictory. It would be better to just use the term "extratropical" when discussing storms which are not of a tropical nature (warm core), and to further divide this category into coastal storms and noncoastal storms. Extratropical storms do occur year-round, but predominate in winter.

(2) In the second sentence it is stated that tropical storms occur in the autumn or early winter. Such storms occur in the summer and fall in this area and virtually never in the winter, as the maps which accompany the discussion indicate.

(3) The third sentence implies that coastal storms are tropical storms and are not extratropical. This is not true. "Coastal storms" usually refers to extratropical storms.

Volume I, page 110, 2nd paragraph: The subject of "Nor'easters" is not covered. These important storms often originate near the offshore areas of the Mid-Atlantic region during winter months and may intensify into extensive storm systems accompanied by strong winds sometimes reaching hurricane force. (See, for example, "Environmental Guide for Seven U.S. Ports and Harbor Approaches," Environmental Data Service, National Climatic Center, Asheville, N.C., 1972.)

Volume I, pages 123-126: There is some confusion in the use of the terms "longitudinal" and "latitudinal" in the descriptions of the variations of temperature and salinity.

Volume I, page 128, 3rd paragraph: While it is true that the Gulf Stream never meanders into the Mid-Atlantic region, the effect of eddies which approach this region makes the surface current dynamics more complicated than pictured.

Volume I, page 139, 2nd paragraph: Tides are first described as semidiurnal, then as diurnal.

Volume I, page 158, 3rd paragraph: The "Data Needs" section would be improved if it included the need for more comprehensive survey data using continuously recording sensors for T °C, S o/oo, and O_2. Data should cover all oceanographic seasons.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL RESEARCH LABORATORIES
Atlantic Oceanographic & Meteorological Labs.
15 Rickenbacker Causeway, Virginia Key
Miami, Florida 33149

January 14, 1976
RF20-43-9(a)5

TO: Dr. William Aron (EE)

FROM: Director, AOML

SUBJECT: DEIS 7512.23 OCS Leasing in Baltimore Canyon Trough

This appears to be as complete a statement as is possible prior to the conclusion of OCS environmental baseline studies now under way through the sponsorship of BLM. Information generated by that study as of the date of compiling the final EIS should be included.

It should be noted that the illustrations on pages 403, 405, and 407 did not reproduce well, and these should be re-done for the final EIS.

Harris B Stewart Jr.

Harris B. Stewart, Jr.
Director

cc: R. Engleman (ERL-OCSEAP)

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Federal Building, 14 Elm Street
Gloucester, Massachusetts 01930

JAN 30 1976

DATE: January 19, 1976

TO: EE - Office of Ecology and Environmental Conservation

Robert L. Schuler

THRU: for F3 - Associate Director for Resource Management

Marvin F. Bowen

FROM: for William G. Gordon
Regional Director

SUBJECT: Comments on Draft Environmental Impact Statement - (Proposed OCS Oil & Gas Lease Sale - Offshore the Mid-Atlantic States - OCS Sale No. 40) (DOI) (DEIS #7512.23)

The draft environmental impact statement for the Proposed OCS Oil & Gas Lease Sale - Offshore the Mid-Atlantic States - OCS Sale No. 40, that accompanied your memorandum of December 18, 1975, has been received by the National Marine Fisheries Service for review and comment.

The statement has been reviewed and the following comments are offered for your consideration.

Specific Comments

Volume 1

II. Description of the Environment

D. Water Quality

1. Offshore and Nearshore

Page 163, footnote 1 - The statement concerning "insignificant impact" to Chesapeake Bay, as a result of Outer Continental Shelf (OCS) oil and gas development, should be discussed in detail. We believe that the impact to Chesapeake Bay may, indeed, be significant, either directly or indirectly, in light of the following recent developments in that area: (1) enlargement of the Chesapeake and Delaware Canal, which should make the highly industrialized ports at Baltimore, Maryland, and in the area of Hampton Roads, Virginia, accessible to larger vessels and increased commerce; (2) the current proposal by Steuart Petroleum Company to enlarge their facility at Piney Point, Maryland, (3) the proposal by Brown and Root, Inc., of Houston to construct facilities at the city of Cape Charles, Virginia, which will provide support for OCS oil and gas operations,

(4) the present construction of an extensive liquified natural gas pipeline, originating at Cove Point, Maryland, by Columbia LNG Corp., and (5) the current application to convert Crisfield, Maryland, into a deepwater port.

Based on the above considerations, it is our opinion that Chesapeake Bay should be included in discussions related to environmental description, potential impacts, and other pertinent narratives. For example, the bay should be discussed under C. 7. Physical Oceanography, Drowned River Mouths: D. 1. Water Quality, Offshore and Nearshore; G. 1. f. Man's Use of the Environment, Land and Water Use, Commercial and Sport Fisheries.

II. D. 1. b. Moriches Bay and Great South Bay

Pages 166-168 - The one-paragraph description of coastal embayments should be clarified. Although some shellfish areas have been closed due to high coliform counts, many are open to commercial and recreational harvesting. In fact, economically important commercial fisheries are supported by abundant populations of bay scallops (*Argopecten irradians*), soft shelled clams (*Mya arenaria*) and, in particular, hard clams (*Mercenaria mercenaria*).

It should also be emphasized that although natural oyster reproduction has declined in recent years, seed oysters are "planted" and grown on privately-leased bottom lands for commercial harvest. The statement that relates a decline in oyster populations to pollution-caused changes in phytoplankton composition should be referenced.

F. Biological Communities

2. Onshore

a. Coastal Vegetation

Page 206, para. 1 - The list of fresh water marsh plants is highly cursory, omitting many prominent species, and should be revised. Big cordgrass (*Spartina cynosuroides*), arrow arum (*Peltandra virginica*), pickerel weed (*Pontedaria cordats*), and arrowhead (*Sagittaria latifolia*) are among the larger, more easily distinguished species that should be included.

G. Man's Use of the Environment

1. Land and Water Use

a. General Description of Land Uses and Distribution

Page 328, para. 2 - Although this paragraph states that the Mid-Atlantic region is subdivided into seven subregions, Figure II-60 illustrates nine subregions, while eight subregions are discussed in the text. These inconsistencies should be resolved.

f. Commercial and Sport Fisheries

Commercial Fisheries

Some of the brief narratives concerned with the biology of commercially important species are more complete than others. Obviously, more facts are known about some species than others. However, we believe that it is important to state unknown features of an organism's biology and, thereby, identify areas of needed research.

This section should also be carefully reviewed for controversial statements and inaccuracies. For example, it is stated (page 453, para. 1), that the Delaware River supports large spawning populations of striped bass (*Morone saxatilis*). This conclusion is in direct opposition to the findings of Chittenden (1971). In addition, it is stated on page 455, para. 2, that alewives and blueback herring are extensively harvested by foreign fisheries. There is very little data to support this contention. By ICNAF agreement, no offshore fisheries are directed at these species; the harvest being incidental to herring and squid fisheries. Also, it is stated (page 455, para. 3) that the blueback herring (*Alosa aestivalis*) spawns in late summer. Actually this species spawns in the Chesapeake tributaries, Delaware River, and Hudson River between late April and late June (Hildebrand and Schroeder, 1928).

All catch data (commercial) and the associated narrative in this section excludes Chesapeake Bay. Although it can be argued that Chesapeake Bay will not be impacted directly by this lease sale, it must be recognized that much of the commercial and sport fisheries of the Mid-Atlantic are directly dependent upon the bay system. Several important species annually move between the bay and coastal ocean (striped bass, bluefish, weakfish, blue crabs, etc.). These species are important to bay fishermen and the presentation of commercial landings which excludes Chesapeake Bay implies a lessening of their importance in the lease area.

i. Ocean Dumping

Page 494, para. 3 - E.I. DuPont De Nemours and Company, Inc., does not dispose of titanium dioxide, the refined product of illmenite ore. It is the manufacture of titanium dioxide that generates large volumes of acid wastes, high in iron chlorides and sulphates, which are dumped into the ocean. Table II-115 is incorrect and should read as follows:

Source	Type	1974 Volume (gallons)
Camden, NJ	Partially digested sewage sludge	15,000,000
Phil., PA	Digested sewage sludge	150,000,000
DuPont	Acid wastes	125,000,000

3. Previous History of Oil Spills in the Regions

This section should be expanded to include all known sources of oil spills in the region and not be limited to tanker accidents and sinkings.

Volume 2

III. Environmental Impact of the Proposed Action

A. Basic Assumptions Regarding Causes of Offshore Environmental Impacts of the Proposed Sale

1. Impacts Resulting from Day-to-Day Operations Under Existing Operating Practices, Regulations, Economics, and Technology

Page 8, para. 2 - Because the terms "TLm" and "TL_{50}" are synonymous, the large discrepancy in bioassay results should be explained. In addition, test organism species should be included in the discussion.

Page 15, para. 4 - It is stated that the final sewage effluent released into the marine environment from offshore rigs and platforms will be chlorinated. Chemical reactions within chlorinated sewage effluent yield harmful chemical compounds, for example chloramines, which are toxic to living organisms. The potential deleterious impact of these compounds to marine biota should be discussed.

Page 16, para. 3 - The statement concerning pipeline burial and economic feasibility should be discussed in greater detail, especially in light of the statement on page 23, para. 2. This statement refers to the belief that more than 92 percent of the volume of oil spilled resulted from ship-pipeline interactions. Economics should not be an overriding factor in its relationship to environmental concerns.

Page 19, para. 2 - The fate of water used to flush abandoned pipelines should be discussed.

Page 22, para. 3 - The sentence beginning "As of 1970" and ending "oil spilled" (mid-paragraph) is incomplete.

B. Impacts of Offshore Oil & Gas Operations on the Natural Environment

2. Biological Communities

a. Impact on the Plankton

This section discusses only fish planktonic larvae, but not invertebrate species which also have planktonic larval stages. These planktonic larval stages may be adversely impacted by OCS activities. Therefore, a discussion of these organisms would be appropriate. The discussion should include, but not necessarily be limited to, the following organisms: surf clam (*Spisula solidissima*), sea scallop (*Placopecten magellanicus*), ocean quahog (*Artica islandica*), American lobster (*Homarus americanus*), rock crab (*Cancer irroratus*), Jonah crab (*Cancer borealis*) southern quahog (*Mercenaria campechiensis*), northern quahog (*Mercenaria mercenaria*), American oyster (*Crassostrea virginica*), softshelled clam (*Mya arenaria*), bay scallop (*Argopecten irradians*), and blue crab (*Callinectes sapidus*). A table, similar to Table III - 21 (pages 76-77) for finfish, would be useful.

Page 80, para. 3 - It is noted that "at this time little is known about the effects (of hydrocarbons) upon them (fish eggs and larvae)." A considerable amount of analytical and assay work has been done on holoplankton, meroplankton, and fish eggs and larvae. Much of this information has been summarized in Moore, Dryer, and Katz (1973).

Page 81, para. 1 - Reasons are given (i.e. high reproductive potential of the species; large numbers of larvae produced) in the last sentence to support the assumption that species survival or distribution will not be permanently affected by oil spills. This statement is questionable from several aspects. One assumption is that planktonic eggs and larvae are uniformly distributed spacially and temporally, whereas egg and larval distributions for some species are in fact not uniform but aggregated. Therefore, a spill in one area may be much more detrimental than in another. Because of differences in spawning times, the time of year in which a spill occurs will be more critical to some species than others. Also, it is assumed that neither chronic, sublethal contamination, nor cumulative effects will reduce species fecundity, geographic range, or larval survival potential. Lastly, a large number of larvae distributed over a broad geographic range need not imply that all larvae of the species have an equal chance of surviving. To the contrary, a large portion of planktonic larvae of a given species may be dispersed into hostile environs and consequently perish.

Page 82, para. 3 - Other adverse effects associated with high turbidities which should be included in the discussion are abrasion, reduced egg buoyance, and increased oxygen demand.

Page 86, para. 3 - Additive and/or synergistic impacts from interaction of the many sublethal impacts (i.e. chronic hydrocarbon release, increased turbidities, osmotic stress, oxygen reductions, etc.) and their potential effects on planktonic organisms should be addressed.

b. Impact on the Benthos

Page 91, para. 2 - It is stated that drill cuttings are deposited and accumulate on the ocean floor. The average volume of cuttings and an estimate of bottom area covered for each rig or platform should be included in the discussion. It should be pointed out that although colonization of drill cuttings may take place, an alteration in sediments may change the biotic community structure.

Page 92, para. 3 (oil spills) - A discussion of potential sublethal effects to benthic invertebrates that may result from either chronic or acute oil spills should be discussed. Causing subtle behavioural and physiological disturbances, sublethal concentrations can reduce an organism's ability to properly function or reproduce. For example, it was found that low concentrations of crude oil decreased molting success and induced autotomy in the tanner crab, *Chionoecetes bairdi* (Karinen and Rice, 1974).

C. Impacts of Oil and Gas Operations on Man's Use of the Offshore Environment

1. Impact on Ports, Shipping, and Navigation

a. Ports

Environmental impacts related to port improvement or expansion to accommodate OCS operations should be described. These impacts include dredge-fill operations with attendant environmental problems (i.e. turbidity, habitat loss, etc.), shoreline stabilization measures (i.e. bulkheads, groins, etc.).

2. Commercial and Sport Fisheries

a. Commercial Fisheries

Page 138, para. 3 - Other sublethal effects resulting from oil pollution which should be described include behavioural disturbance, physiological imbalances, and abnormal larval development.

D. Onshore Impacts of Oil and Gas Operations

2. Impacts on the Natural Environment

b. Beaches

Page 260, para. 2 - The possibility of accelerated dune erosion as a result of pipeline installation should be discussed.

d. Wildlife

Page 269 (Endangered Species) - Because the anadromous short-nosed sturgeon (*Acipenser brevirostrum*), an endangered species, is subject to stresses generated by onshore development, this finfish should be included in the discussion. The possible effects on migration and spawning success should be described.

e. Water Quality

A discussion describing the effects of dredging, filling, bulkheading, and other similar onshore development activities on water quality should be included in this section.

Page 273, para. 1 - The statement, similar to that on page 69, para. 1, referring to any deterioration of water quality as being only "incremental" understates the problem. Offshore, as well as onshore, related OCS activities tend to degrade water quality in many ways, each of which is incremental. Incremental offshore activities which pollute water include discharge of formation waters, drill cuttings, drilling muds, and sewage from rigs and platforms; discharge of bilge and debris from service vessels; and dredge and fill activities associated with pipeline burial. Onshore operations which incrementally contaminate water are dredge and fill projects, shoreline stabilization measures, moorage facility construction, increased upland run-off with attendant pollutants, and effluent discharges. Cumulatively, these degrading influences will work with other industrial and residential practices to debase water quality, reduce biological productivity, and generally, diminish the viability of the ecosystem. We, therefore, suggest that the statement be revised to reflect the potential adverse impact of incremental degradation.

G. Summary Risk Analysis

Page 302, para. 2 - The last statement in this paragraph concerning risk potential seems contrary to that in Volume I, page 25, last sentence. The Volume II statement concludes that none of the tracts have a high risk potential, while the one in Volume I implies the opposite. This conflict should be resolved.

H. Cumulative Impacts of the Proposed Sale and Other Federal Actions

Pages 304-311 - Many cumulative impacts which are expected to result from both primary and secondary OCS related development are not addressed in this section. Such impacts originate from industrial and residential construction in coastal areas. The construction, consisting of dredging and filling of shallow water and wetland habitat, as well as shoreline stabilization and moorage facility construction, contributes to the incremental, and often permanent destruction or alteration of biologically productive habitat. Such shore development projects are subject to review and approval under provisions of federal legislation (i.e., Section 10 of the River and Harbor Act of 1899, and Section 404 of the Federal Water Pollution Control Act Amendments of 1972). Therefore, the potential cumulative adverse environmental impacts generated by these projects should be addressed.

IV. Mitigating Measures Included in the Proposed Action

C. Oil Spill Containment and Cleanup

4. Status of Oil Spill Containment and Cleanup Technology

Pages 341-343 - The information presented in this section is very general and should be more specific. For example, limits for boom and skimmer efficiency (i.e. maximum wave height and wind speed), types of chemical absorbants and adsorbants, and types of burning agents should be discussed. Information concerning types of chemical dispersants,their toxic effects, and toxicity concentrations should be included also. Recognizing that some, but not all, of these data are presented on pages 415-417, we believe that a detailed discussion of containment and cleanup technology is appropriate in this section.

V. Adverse Environmental Impacts Which Cannot be Avoided Should the Proposal be Implemented

A. Marine Organisms

Page 369, paras. 2 and 3 - Other adverse impacts resulting from increased turbidity include physical abrasion, decreased egg buoyancy, and possibly reduced dissolved oxygen concentrations.

C. Wetlands and Beaches

Pages 272-273 - Potential secondary impacts on wetlands and beaches originating from increased residential and industrial development in coastal areas should be discussed.

D. Water Quality

2. Onshore

Page 375 - Potential water quality degradation resulting from coastal development stimulated by OCS operations should be addressed.

VII. Irreversible and Irretrievable Commitment of Resources Which Would be Involved in the Proposed Action Should it be Implemented

C. Fish and Wildlife Resources

Page 394, para. 3 - The possibility of permanent loss or alteration of aquatic and wetland habitat as a result of coastal development stimulated by primary and secondary OCS activities should be addressed.

General Comments

The discussion of oil spill trajectories in the Mid-Atlantic region by the authors of the model (Pg. 52 Vol. II) admits to the lack of reliable input data for the program. Analysis of potential oil spill trajectories is in our view critical to leasing and development decisions, including the analysis of environmental aspects required under provisions of the National Environmental Policy Act. This analysis is also critical to identifying candidate sites for environmental studies. For these reasons, we suggest that consideration be given to recommending that an independent review be given to the oil spill trajectory evaluations described in this draft document prior to the issuance of the FEIS.

Also, the draft impact statement identifies a number of scientific studies published outside the United States but does not include any great number of foreign translations. The Language Services Division, Office of International Fisheries, National Marine Fisheries Service, maintains an overview of those scientific papers which are available in translated form. For information, we have included a list of selected translations, which may be germane to the issues addressed in this particular impact statement. We would encourage BLM to become familiar with this service in relation to this and future activities in the marine environment.

Three copies of the Final EIS are requested.

cc: F34(3) FNE(2) FNE21(Lippson)

LITERATURE CITED

Chittenden, Mark E., Jr. 1971. Status of the Striped Bass, Morone saxatilis, in the Delaware River. Chesapeake Science 12(3): 131-136.

Conrad, Henry S. 1935. The Plant Association of Central Long Island. The American Midland Naturalist 16(4): 433-516.

Hildebrand, Samuel F. and William C. Schroeder. 1928. Fishes of the Chesapeake Bay. Bulletin of the United States Bureau of Fisheries. Vol. XLIII, Part I. pp. 85-89.

Karinen, John F. and Stanley D. Rice. 1974. Effects of Prudhoe Bay Crude Oil on Molting Tanner crab, Chionoectes bairdi. Marine Fisheries Review 36(7): 31-37.

Moore, Stephen F., Robert L. Dwyer and Arthur M. Katz. 1973. A Preliminary Assessment of the Environmental Vulnerability of Machias Bay, Maine, to Oil Supertankers. Massachusetts Institute of Technology, Report No. MITSG 73-6. pp. 63-110.

SELECTED FOREIGN TRANSLATIONS

Aliakrinskaya, I.O. 1966. Experimental Data on Oxygen Consumption by Sea Water Polluted with Oil. OKEANOLOGY 6(1): 89-97.

Kasymov, A.G. and S.I. Granovskiy. 1970. The Effect of Petroleum on Bottom Animals in the Caspian Sea. Hydrobiological Journal 1970(5): 85-88.

Mironov, O.G. 1967. The Effect of Small Concentrations of Oil and Oil Products on Developing Eggs of the Black Sea Turbot. Problems of Ichthyology 7(3).

____________. 1969. The Development of Some Black Sea Fishes in Sea Water Polluted by Petroleum Products. Problems of Ichthyology 9(6): 919-922.

____________. 1969. Viability of Larvae of Some Crustacea in Sea Water Polluted with Oil-Products. Journal of Zoology 48(11): 1734-1737.

____________. 1969. The Effect of Oil Pollution upon some Representatives of the Black Sea Zooplankton. Zoological Journal 48(7): 980-984.

Smith, J. 1969. "Torrey Canyon" Pollution and Marine Life - A Report by the Plymouth Laboratory of the United Kingdon. Hydrobiological Journal 1969(2): 72-74.

Turpaeva, D.P. and P.P. Shirshov. 1971. The Influence of Man on Marine Ecosystems. in K.V. Beklemishev (ed.) Fundamentals of the Biological Productivity of the Oceans and their Exploitation. Nauka, Moscow. pp. 264-282.

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:
DAEN-CWR-P

6 February 1976

RECEIVED
FEB 9 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

Mr. Curt Berklund
Director (732)
Bureau of Land Management
Department of the Interior
Washington, D. C. 20240

Dear Mr. Berklund:

The draft environmental impact statement concerning a proposed Mid-Atlantic Outer Continental Shelf Oil and Gas Lease Sale (OCS #40) has been reviewed. Our comments are inclosed.

We appreciate the opportunity to review this statement.

Sincerely yours,

John R Hill Jr.

JOHN R. HILL, JR.
LTC, Corps of Engineers
Assistant Director of Civil Works,
Environmental Programs

1 Incl
As stated

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT (circulated 10 Dec 1975)
Proposed OCS Sale # 40

The language used on page 326 of Volume 2 of 3 is imprecise as it describes the "United States Army Corps of Engineers." It is suggested that the last sentence of that section be rewritten to reflect the provisions of 33 CFR 209.120 as amended in the Federal Register of Friday, July 25, 1975 at pages 31320 et seq.

In particular the words "will be provided" must be replaced by "will be processed..." to avoid pre-empting the Corps decisions in this matter.

Further the specific language below (drawn from 33 CFR 209.120) is pertinent.

"Policies on Particular Factors of Consideration. In applying the general policies . . . to the evaluation of a permit application, Corps of Engineers officials will also consider the following policies when they are applicable to the specific application:

Outer Continental Shelf

Artificial islands and fixed structures located on the outer continental shelf are subject to the standard permit procedures of this regulation. Where the islands or structures are to be constructed on lands which are under mineral lease from the Bureau of Land Management, Department of the Interior, that agency, in cooperation with other Federal agencies, fully evaluates the potential effect of the leasing program on the total environment. Accordingly, the decision whether to issue a permit on lands which are under mineral lease from the Department of the Interior will be limited to an evaluation of the impact of the proposed work on navigation and national security. The public notice will so identify the criteria."

It is suggested that the Baltimore District be included as a possible Commenting Office.

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (G-WS/73)
WASHINGTON, D.C. 20590
PHONE: 426-2262

24 MAR 1976

RECEIVED
MAR 25 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

Mr. Frank A. Edwards
Assistant Director, Minerals Management
Department of the Interior
Washington, D. C. 20240

Dear Mr. Edwards:

This is in response to your letter of 10 December 1975 addressed to the DOT Water Resources Coordinator concerning a draft environmental impact statement for a proposed Mid-Atlantic Outer Continental Shelf Gas and Oil Lease Sale offshore New Jersey and Delaware.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. The Coast Guard had the following comments to offer:

"We have strong reservations about offering outer continental shelf tracts for oil and gas exploration or development if they coincide with substantial vessel traffic. Tracts 553, 554, 598, 599 and 643 (Visual-1) are located partially within an existing Traffic Separation Scheme. Tracts also exist in the Cape Henlopen to Five Fathom Bank traffic lane extension (Section III.C.1.c). Additional heavily trafficked areas might possibly be identified using satellite information from NOAA. The statement on page 131, Volume II, that 'very little interference with navigation is to be expected between ships which utilize existing traffic lanes and drilling rigs or platforms' is valid only if our recommendation is followed to exclude these activities from tracts within existing or proposed Traffic Separation Schemes.

"The Outer Continental Shelf Lands Act and Title 33, part 67 of the Code of Federal Regulations specify that the Coast Guard is responsible for the navigational marking of structures on the outer continental shelf. Therefore, special stipulation No. 7, which states that such structures 'shall be adequately marked according to methods determined by the Supervisor' should read 'determined by the Coast Guard.'

"It is emphasized throughout the report that one of the most significant adverse impacts associated with the project is the potential for an oil spill during transportation from production platforms to onshore storage facilities. The mode of oil transport is, therefore, crucial to assessing environmental impact. Since tankers may be used in addition to, or instead of, pipelines, the final impact statement should include a more direct and detailed comparison of the impacts associated with tanker and pipeline transportation than is presently contained in Section III.A.2.

"The draft impact statement does not consider the possibility or consequences of an emergency on an offshore platform requiring the evacuation of personnel. We recommend that the lessees develop a capacity for emergency evacuation of platforms and be required to submit an emergency evacuation plan as a condition of their lease. This should be addressed in the final impact statement.

"It is imperative that mariners be warned of the existence of offshore exploration activity. Therefore, it is requested that a further stipulation be added to the terms of the lease contracts: that the Coast Guard be notified of the precise latitude and longitude of any drill ship, rig or structure activity on the OCS 90 days prior to commencement or termination of the position of the hazard to navigation.

Detailed comments on the DEIS

"The following comments are limited to areas of Coast Guard jurisdiction by law or special expertise, or as stipulated in the Council on Environmental Quality's Guidelines for the Preparation of Environmental Impact Statements (1 August 1973).

I. Description of the Proposal

"The second sentence of paragraph- 2, Section I.F.1.a. should read 'offshore structures require permits to assure that navigation is unobstructed and to ascertain that...' In addition, this paragraph should make a clear distinction between the prevention of obstructions to navigation, which is within the jurisdiction of the Secretary of the Army, and the navigational marking of structures, for which the Coast Guard has responsibility.

II. Description of the Environment

"The acid waste dump site no longer consists of seasonal tracks as shown in figure II-83 but is now a quadrangular area.

III. Environmental Impacts of the Proposed Action

"Figure I-3 on page 22 of volume I shows that only four months are allotted for the collection of base line data for the proposed OCS lease sales. Such a short collection period does not permit the collection of data over a full seasonal cycle which is required for a valid assessment of many environmental parameters.

"On page 44 of Volume I, the Environmental Protection Agency's Spill Prevention Control and Countermeasure Plan (SPCC) is mentioned in the paragraph on oil pollution. In addition to this plan, a Coast Guard operations manual is required for all large oil-transfer facilities (i.e., transfer of oil to or from a vessel of 250 or more barrels capacity) and national, regional and local oil pollution contingency plans have been developed under the authority of the Federal Water Pollution Control Act. These additional plans should also be mentioned.

"On page 119 of Volume I, percentage frequencies of offshore reduced visibility are given in table II-9; however, the locations and reliability of these figures/observations are not indicated. Since the construction of offshore production platforms in areas of high vessel traffic are a real possibility, the reliability of this data is important.

"Pages 19 through 34 of Volume II discuss the probability of oil spills from OCS operations. This analysis is based, in part, on the Geological Survey's data for production spills in the Gulf of Mexico OCS area. U. S. Coast Guard data on offshore production indicates a much higher frequency of oil spills, as follows:

Year	Number of spills	Gallons spilled
1974	2,006	153,771
1973	1,955	875,202
1972	2,317	237,063*
1971	2,595	662,203*

*Includes oil spills from all offshore facilities.

NOTE: In addition, the August 1975 collision between the GLOBTIK SUN and an offshore platform in the Gulf of Mexico is worthy of discussion to illustrate the possible impacts of a major accident.

"In reference to the computer simulations of oil spill trajectories in Section III.A.4, the first sentence in paragraph-2, page 65, is incorrect. Water current data were generated on an hourly basis using an HN model, and data from a real storm were used.

"Because of the possibility of adverse impact on vessel traffic (Section III.C.1.b. page 121), it is important that the Coast Guard be kept fully informed of all project vessels during pipe laying and exploration so that notices to mariners may be published as necessary.

"Pages 123 through 130 Volume II discuss the navigational impacts of OCS production platforms in terms of the Gulf of Mexico experience. Several factors should be examined in greater detail:

"(1) No production platforms should be located in vessel traffic lanes; directional drilling techniques should be used to extract oil and gas from these areas;

"(2) No data is presented on offshore vessel traffic patterns (because the present traffic lanes do not extend into the proposed lease sale area, this may be of critical importance in analyzing the possible risk of vessel/platform collisions); and,

"(3) The weather conditions in the Atlantic OCS region are generally more severe than those of the Gulf OCS, and therefore, the Gulf experience may not be transferable to the proposed lease area.

"On page 132, Volume II, it is stated that 'the volume of crude oil receipts would be the same, regardless of the source of the crude.' This assertion is open to questions in view of possible increased production or capacities in present refineries and a possibility of new refineries in the region. This has implications for vessel traffic generated by the distribution phase of the oil industry.

"The land use requirements in Table III-28 on page 219 of Volume II do not include secondary development, e. g., housing, shopping centers, schools, etc., for the new employment population described on pages 164 through 177. If this employment is concentrated in presently undeveloped areas, e. g., Cape May County, New Jersey, these land use impacts may be quite great.

"It is apparent from the discussion of pipeline spills in Section III.D.i.e., page 232, that nearshore pipeline oil spills pose the greatest danger to the coastal environment because they have less time to dissipate before reaching shore and occur more often than drilling related spills. Therefore, more detailed information should be included in Section III.d. to determine the extent and severity of oil spills resulting from pipeline accidents. This should include an estimate of oil spilled for particular types of pipeline accidents and the time required to isolate a break. Also, the terms 'significant leak' and 'minor leak' on page 239 should be quantified, so as to permit evaluation.

"In Section III.D.1.e. page 239, it is stated that 'periodic beach patrols of pipeline corridors...may be undertaken' and in Section IV.A.1,b, page 318 that 'no specific inspection schedule has been established for this Mid-Atlantic area to date.' In view of the importance of these inspections for identifying minor pipeline leaks, and considering the states' jurisdiction in nearshore waters, a discussion of the capabilities and resources available at the state level to perform these patrols should be included in the final statement. In Volume II, page 318, paragraph 2, lines 2 and 3: '...with vessels and aircraft.' is suggested in lieu of 'boat and airplanes.'

IV. Mitigating Measures Included in the Proposed Action

"Copies of the Operator Reports discussed in Section IV.A.1.b. should be sent to the Third Coast Guard District (mep) for inclusion in the computerized Pollution Incident Reporting System.

"On page 324 of Volume II mention is made of the fact that no Coast Guard surveillance plans are yet developed for the Atlantic OCS area. Present oil pollution and law enforcement patrols by Coast Guard aircraft do cover this area to a limited extent, and it can be expected that with OCS development, and/or a 200-mile limit, these patrols would be expanded.

"On page 337 of Volume II, it is mentioned that the criteria for dividing inland and coastal waters is navigability by a 40 foot Coast Guard boat. This is not the case; the dividing line between inland and coastal waters is defined in each Regional Oil Pollution Contingency Plan.

"The criteria for response by the National Strike Force to a spill of over 50,000 barrels mentioned on page 338 of Volume II is incorrect. The National Strike Force responds to spills at the request of an On-Scene Coordinator, and in many cases, has responded to much smaller spills.

"The discussion of oil spill containment and cleanup technology on pages 341 through 343 of Volume II does not include any mention of the effectiveness of this technology in removing oil spills. An idea of the amount of oil which can be removed under various environmental and spill conditions would be appropriate.

"To adequately assess the implications and potential impacts of pipelines located along various segments of the coastline, it would be of considerable value to know the general areas being considered for pipeline corridors. Therefore, it is suggested that the first phase of the proposed pipeline corridor management studies (Section IV. D. 3.d.), involving the identification of tentative corridors, be conducted prior to, and incorporated in, the final impact statement.

"In view of the inadequacies of available methods for determining oil spill trajectories, the ongoing studies and data collection associated with the proposed project offer the Department of Interior an excellent opportunity to initiate a program to develop a more reliable real-time predictive model to assist in Federal response to an offshore oil spill."

We have no other comments to make nor do we have any objection to this project. The final statement, however, should address the concern of the Coast Guard.

The opportunity to review this draft statement is appreciated.

Sincerely,

D. J. RILEY
Captain, U. S. Coast Guard
Acting Chief, Office of Marine
Environment and Systems

DEPARTMENT OF TRANSPORTATION
MATERIALS TRANSPORTATION BUREAU
WASHINGTON, D.C. 20590

RECEIVED
APR 16 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

APR 14 1976

Mr. Frank A. Edwards
Director, Bureau of Land Management
U. S. Department of the Interior
Washington, DC 20240

Dear Mr. Edwards:

The Office of Pipeline Safety Operations (OPSO) in the Materials Transportation Bureau (MTB) has reviewed the subject "Draft Environmental Statement" concerning the proposed 1976 leasing of 154 tracts on the Mid-Atlantic Outer Continental Shelf in an area known as the Baltimore Canyon Trough.

OPSO has limited its review to pipeline facilities. We have the following comments for your consideration for inclusion in the final environmental statement.

1. On pages 312, 324, and 354 of Volume 2, please correct to read, Office of Pipeline Safety Operations in the Materials Transportation Bureau instead of Office of Pipeline Safety. This is an updating in line with the reorganization of pipeline safety responsibilities in the Department.

2. Page 325 of Volume 2 made reference to 49 CFR Parts 192 and 195 and pages 595 and 596 also of this volume made reference to some specific sections of these regulations.

With regard to 49 CFR Parts 192 and 195 and the referenced specific sections of the regulations, MTB is in the process of amending the regulations. The proposed amendments will more clearly delineate the applicability of the regulations to offshore gas and liquid pipelines.

3. In reference to page 354 of Volume 2 regarding MTB's jurisdiction over all pipelines on Federal lands, this authority does not extend to pipelines on Federal lands owned or operated by Federal agencies. The extent of the Department's involvement in these Federally owned or operated pipelines is to cause the examination of these pipeline facilities once a year, cause the prompt reporting of any potential leaks or safety problems, and report annually to the President, the Congress, Secretary of the Interior, and the Interstate Commerce Commission of any potential leaks or actual explosions and spillages in these pipelines.

If we can be of any further assistance in this matter, please let us know.

Sincerely,

Cesar DeLeon
Acting Director
Office of Pipeline
Safety Operations

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

MAR 16 1976

RECEIVED
MAR 17 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

Mr. Frank A. Edwards
Assistant Director
Minerals Department
Bureau of Land Management
Department of the Interior
Washington, D.C. 20240

Dear Mr. Edwards:

This is in response to your transmittal dated December 10, 1975, inviting the Energy Research and Development Administration (ERDA) to review and comment on the Department's draft environmental statement prepared by the Bureau of Land Management (BLM) to support a proposed mid-Atlantic Outer Continental Shelf oil and gas lease sale (OCS Sale #40) offshore New Jersey and Delaware. We have reviewed the statement and are providing comments herein and in the enclosed ERDA Staff Comments for your consideration in the preparation of the final statement.

After review of the statement, it is apparent that a reasonable inventory of the biological resources of the proposed leasing area has been presented; however, one is left with the impression that there is insufficient information available on the marine environment in the Baltimore Canyon area and the environmental base line studies currently being undertaken by BLM may conceivably be necessary for satisfactory environmental evaluation of the proposed actions. In this respect, specific concern is with the discussion of the impact of offshore oil and gas operation on the natural biological community environment (section III, B2a, b, c).

A good presentation has been provided within the levels of the available data; however, the data sets offer no indication of the importance of transients within the system. We feel that these can be very important in moving sand along the bottom, contributing to water motion in the water column, fostering shunts of energy to different food chains, i.e., herbivory in the form of tintinnids or salps instead of copepods, and leading to mass mortality of organisms such as the disappearance of tile fish in the Middle Atlantic Bight during 1882. It might have been worthwhile to attempt to construct a mass budget for the available data to see if all of the important energy pathways were considered in the inventory.

For example, considerable effort has been expended on studying seasonal aspects of the Middle Atlantic Bight ecosystem. A fair amount is known about the hydrography and residual drift currents of the area, the nutrient structure of this system, the primary productivity of these waters, the zooplankton biomass on the shelf, the distributions of icthyoplankton and adult fish within the Bight, and finally, the benthos and sediments of this coastal ecosystem. An initial model of the coastal productivity of this area has been developed as well.

Recent physical studies of the Middle Atlantic Bight have involved more sophisticated theory and moored current meter records over shorter time intervals. In contrast, recent biological studies have been mainly concerned with the quasi-steady state impact of eutrophication and acid wastes with little emphasis on the effects of transient dynamics within natural ecosystems. In an attempt to understand, monitor, or predict the impact of oil releases on a marine system, moreover, the applicability of just either these static low resolution field data or laboratory results from only those organisms amenable to culture is questionable without additional information on relevant scales of variability of the total system.

With respect to specific impacts of the proposed energy development of the outer continental shelf, it is suggested in the statement that offshore spills will have little effect on the coastal zone; however, most of the commercial fishing is done at the shelf edge, which will be closer to the proposed lease area. There is little discussion of the fate of aromatic compounds, which are some of the more toxic materials. In citing both detrimental and perhaps beneficial responses of phytoplankton and zooplankton to various oil fractions, it is not clear how the conclusions can be made that there will be little effect. No attempt has been made to evaluate the conflicting results in a scientific manner. The high reproductive potential of fish is of marginal value, if there are few adults because of overfishing, and if, an additional stress is placed on the very sensitive larval forms; it is now thought that fluctuation of fish stocks are directly related to the survival of cohorts in this life stage.

Furthermore, what is a local effect? There is no attempt in this report to discuss spatial or temporal scales of variability. For example, how many ppb of oil might be spilled over what area, affecting how much phytoplankton, zooplankton, icthyoplankton, and benthos? Suppose there were 4 spills in a row, what rate of dilution would lead to how large an area that would have oil concentrations above the sensitivity threshold of larval forms? Considering the utilization of a physical model, we are surprised that a biological model has not been used. Such an exercise would both summarize the available toxicity data and allow additional, but still unverified, conclusions on the likely impact of this activity.

The combined field programs of physical and biological oceanography at ERDA's Brookhaven National Laboratory (BNL) may be of help to BLM in the future. The development of electromagnetic current meters provides data on transient physical forcings of the euphotic zone for the first time on a continental shelf. Seasonal cruises emphasize the biological response of the shelf communities to these natural perturbations, i.e., internal waves, storms, etc., with both time series and rate measurements of the important variables. Laboratory experiments are run concurrently to corroborate the field observations in a team approach to address systems questions about the response of the continental shelf ecosystem to man's perturbations.

BNL is also using non-linear, spatial simulation models for both analysis of historical data and for synthesis of data on natural transients within the marine environment. BNL studies of natural mortality of the marine food-chain within the mid-Atlantic Bight and the biological response to physical dynamics of the ocean will both provide validation information for use of these simulation models as decision tools, and will provide the necessary understanding to go beyond the present inadequacy of "conventional wisdom" about the steady state behavior of marine ecosystems.

We are naturally concerned over the possibility of oil spills and fouling of the excellent and extensive beaches of this prime recreation area of the northeast. Fouling of these beaches would deter visitors and impact heavily on the economy which is dependent on this income. In this regard, we feel that the Coast Guard work on the problems of oil spill cleanup and reduction is well documented and referenced. The statement also adequately discusses the disadvantages of the two Coast Guard models of oil spill trajectories if they are used in assessing the impact upon the coastal environment from OCS related spills. These essentially consist of the models' dependence upon monthly averages of wind and current data or upon idealized winter and summer weather conditions. However, a MIT model was used for these trajectories in the statement (section III.A.4).

The residual current is a hypothetical ambient background southwest current of 0.25 knots (5 cm/sec) that is constant annually. It has been shown that observations and computations indicate the currents can vary by a factor of ten in either direction from the hypothetical current in a day, not including tides. The wind speed is assumed to be constant seasonally, except that historical observations have indicated that each three hours it can shift to one of eight directions (plus calm).

The model used does not compute the path of oil in the water column and thus cannot be used to assess the effects of suspended oil on the many different species in the marine energy cycle. It also does not attempt to predict the area of impact (as acknowledged by the authors) and thus it is of limited usefulness in assessing hazards to particular coastal regions from OCS operations. However, the model has shown that some proposed drilling sites do pose seasonal risks of varying nature during the year.

We suggest that BLM might want to consider reevaluating the hazard by means of a more sophisticated oil spill model developed by ERDA's Brookhaven National Laboratory. The formula for the oil surface trajectory is the same as that used in the MIT model, but the meteorological and oceanographic conditions in the vicinity of the estimated drilling sites can be more realistically simulated. In particular, the areas of impact can be estimated by running the model in a statistical mode, and spill scenarios can be simulated in a real-time mode for both the surface slick and oil suspended in the water column. The model has been applied to the New York Bight and validated against current data taken by Brookhaven in September 1975 and drift card data taken during the winter of 1973-1974. The computed currents also exhibit a gyre in the New York Bight Apex in accordance with observations taken for the MESA project. Input data required are the bottom topography and synoptic wind observations which are available at BNL. The details of the model are discussed in Enclosure 2 to this letter, where it is shown that it may be possible to evaluate particularly hazardous situations in detail. We believe this model to be the best state-of-the-art model available on oil spill trajectories and can make it available if you so desire.

We would like to address certain areas of the statement which speak to alternative forms of energy. The statement is made (page 433) that it is unlikely that a syncrude industry will be advanced enough to make a significant contribution to U.S. energy supplies, even by the year 2000. In a report submitted by the Synfuels Interagency Task Force to the President's Energy Resources Council in June 1975, total energy demand is estimated at 158.9 Quads-Btu in the year 2000 and synthetic fuel production at 11.0 quads in this same year. This is almost 7.0% of total demand and in our opinion represents a significant contribution.

Addendum to page 4 of Energy Research and Development comments.

Note: The following sentence was changed by ERDA by phone. "In a report submitted by the Synfuels Interagency Task Force to the President's Energy Resources Council in November 1975, total energy demand is estimated at 158.9 Quads-Btu in the year 2000 and synthetic fuel production at 22.0 quads in this same year. This is almost 14.0% of total demand and in our opinion represents a singificant contribution."

With reference to the production of synthetic oil from Appalachian coals, we envision that a synthetic crude oil capacity in this region by the year 2000 will make a significant contribution to northeast energy needs. The demand for oil in the industrialized east is substantial and synthetic oil and gas from Appalachian coals should not, we think, be summarily dismissed.

The conservation section (volume 2, pages 419-421) draws no distinction between energy conservation through curtailment and energy conservation by promoting more efficient use of energy, the latter having a much lesser impact on the quality of life. Inasmuch as the major thrust of ERDA's conservation efforts are towards increasing energy utilization efficiency, we would prefer that a distinction be made. In the environmental statement for OCS Sale No. 41 (volume 2, pages 576-578), the section on energy conservation, while by no means exhaustive, does not confuse the two general types of energy conservation. Therefore, we suggest that the language from the latter document be used in the subject impact statement.

The discussion of the geothermal energy alternative should not be limited to the production of electric power. Geothermal resources in many areas offer the potential for space heating, industrial processing, and other non-electric uses which currently are heavily dependent upon oil and gas.

The nuclear alternatives section creates the impression that unless the OCS oil and gas leases are granted, it may be necessary to build 3-18 1000 MWe nuclear plants to supply an equivalent amount of energy on a Btu basis. The analysis is somewhat misleading since nuclear power is used basically to produce electrical energy. Nuclear power might best be used as a direct substitute for only the viscous residual fuel oil (RFO) fraction of crude oil (about 7.7%) and gas (about 17.8%) which are used by utilities to generate electricity.

We suggest that the cost-benefit analysis of alternatives to the development of OCS oil reserves might be strengthened by presenting the costs for each energy alternative from the viewpoint of the consuming public. For convenience, it might be helpful to include an estimate of the unit cost of energy supplied under each alternative (e.g., $/million Btu's).

We would like to suggest that future statements contain a chapter-by-chapter summary to aid in the review of the document.

Thank you for the opportunity to provide these comments and the enclosed staff comments (enclosure 1). We hope they will be helpful in the preparation of the final statement.

Sincerely,

W. Pennington

W. H. Pennington
Assessments and Coordination
Officer
Division of Biomedical and
Environmental Research

Enclosures:
1. ERDA Staff Comments
2. BNL Oil Spill Trajectory Model

cc w/enclosures
CEQ (5)

ENCLOSURE 1

ERDA STAFF COMMENTS ON THE
USDI/BLM DRAFT ENVIRONMENTAL STATEMENT

PREPARED FOR THE

PROPOSED OUTER CONTINENTAL SHELF
OIL AND GAS LEASE SALE
OFFSHORE THE MID-ATLANTIC STATES
(OCS SALE NO. 40)

1. Biological Aspects

Volume II, Section F.

The effort to extract relevant information from the scientific literature is impressive and apparently thorough throughout pages 74-109, 134-140, 260-266, 359, 369, 394, and 623-709. The biological sections appear to be well done.

Volume III.

The illustrations are very difficult to read and interpret.

2. Meteorology and Air Quality Aspects

Section II.B.

This section is adequate except in section 4 on Atomspheric Disturbances; the tropical storm statistics should be updated to the present time.

Section II.E.

As detailed, air quality in the Middle-Atlantic States is not the best. The states have strong viable plans but the combined effects of prevailing meterology, population and industrial activity lead to frequent pollution episodes, particularly when the area is under the influence of an extensive Bermuda High. No discussions of offshore activities on air quality are made.

3. Geological Aspects

Section II.A.

This section appears to be competently and adequately done in view of the relatively small amount of information available on the sediment and rocks of the sea floor. Certainly, sources of geological information are limited here as compared with dry land.

Page 50.

On the "Geologic Time Chart," one name of an age division of the Cenozoic Era is given as "Recent." In the body of the statement, this is invariably referred to as the "Holocene." We suggest changing "Recent" in the chart to "Holocene."

Page 52.

There is the following: "...prospective carbonates (limestone, dolomite, anhydrite)...." Limestone and dolomite are carbonates, but anhydrite is not. We suggest the following wording: "... prospective calcareous rocks (limestone, dolomite, anhydrite)..."

4. Physical Oceanography Sections

We find the discussion quite simplified and generally out of date. Important information from NSF studies at the Cheasapeake Bay Institute have been omitted. Recent literature frequently documents the intrusion of Gulf Stream Water onto the shelf, yet, on page 178 (vol. I), the statement reports that the Gulf Stream Water Mass never extends into the area of interest and can be neglected. More over, the discussion dismisses offshore sources of water as a modifying factor in the Shelf Water Mass. Since this process has significant influence on the trajectories, oil spills may take place on the shelf. We find the above omissions indicative of insufficient technical input into the statement.

The statement might acknowledge on page 162 the ERDA coastal oceanography program as making important contributions to this effort. This program was begun during the days of the Atomic Energy Commission and is well known to the oceanographic research community on the east coast.

The writers have done about as good as can be expected on applications of present state-of-the-art oil trajectory models. Unfortunately, the average circulation conditions used in the model are totally unrealistic because of the long averaging time used. Perturbations in currents and wind forcing are likely to greatly exceed the averages used many times over 40 to 80 days (the predicted transit time of oil).

5. Water Quality Aspects

The general information content is adequate in this section also, as references are included from very old studies such as the WHOI group in the early fifties as well as very new studies, such as NOAA's MESA continuing effort. Both of these, as well as many interim studies, provide a poor resolution of the anticipated water quality problem areas in the Mid-Atlantic region. It is unfortunate if the BLM had to use this general information as a baseline from which the impacts of their OCS activities had to be measured.

The treatment in volume II of the proposed OCS activity is in our opinion inadequate as no quantitative, and in many cases not even qualitative, estimates are made of the consequences of OCS activities. We suggest that the following impacts might be quantified in the final statement:

> Page 67
>
> "Oil spill and discharge of formation waters and drilling muds...will cause an effect on water quality...which is not quantifiable at present."
>
> Page 69
>
> "During peak production...oil introduced via formation waters would be about 1000 gallons per day...which would produce only incremental increases in the hydrocarbon levels in area waters."
>
> "Cumulative effects over time are not determinable at present."
>
> Page 70
>
> "Any deterioration of water quality by the additions of formation waters would be extremely localized."
>
> "Actual lowering of oxygen levels would not occur."
>
> Page 72
>
> "There will be no problems resulting from oil spills, discharge of formation waters and pipeline burials."
>
> Page 73
>
> "The impact cannot be determined from the additions of treated sewage to the surrounding water."
>
> "Quantities and effects of displacement of up to 9 million cubic yards of sediment will be investigated more fully later."

6. Nuclear Power Alternatives

Page 434.

Last paragraph. The statistics regarding nuclear power production in the U.S. should be referenced. Change "March 31, 1975," to "December 31, 1975". Change "35,000 MW," to "37,500 MW". Change "1974" to "1975".

Page 435.

Lines 1 and 2. To clarify its meaning, this sentence should be restated as follows: "In order to meet future uranium fuel requirements, it will be necessary to locate additional ore reserves through increased exploratory drilling activity."

Page 435.

First paragraph. Suggested replacement: "Fuel cycle costs of nuclear reactors have increased only slightly since 1965, from a range of about 17¢ to 22¢ per million Btu, to about 30¢ in 1974."

"For comparison in October 1974, the cost of coal was 81¢ per million BTU and oil was 99¢ per million BTU."

"Although reactor capital costs continue to increase, the gap between unit capital costs for coal-fired and nuclear plants is narrowing. The cost of 1000 MW(e) plants entering service in early 1983 would be about $720/KW(e) for a nuclear plant and $626/KW(e) for a coal-fired plant.[1] Fossil-fuel plants are now subject to larger environment-related cost increases and must bear the same financial burden as nuclear units (inflation, higher interest rates, cost escalations during construction)."

"Nuclear electric generation costs continued to be the lowest in 1975 - 11.4 mills/KW-hr for nuclear units, compared with 15 mills/KW-hr for coal and 33 mills/KW-hr for oil. For the first half of 1975 utilities have been maximizing production from their nuclear plants which now have higher capacity factors than fossil units.[2]"

"[1] WASH-1345 - Power Plant Capital Costs, Current Trends and Sensitivity to Economic Parameters, October 1974, p. 11."

"[2] "Info" - Atomic Industrial Forum, September 1975."

We suggest that reference 1 on page 435 not be used. It is quite speculative. We have indicated in the suggested change a more objective and more recent sources of information on nuclear power economics.

Page 435.

Second complete paragraph. In the second sentence, insert "much" before "less."

Page 436.

First complete paragraph. In the first sentence, replace "an AEC" with "a Federally licensed." Also, the last sentence should be restated as "Currently, spent fuel is stored at NRC licensed facilities. Plans call for recovering unused fuel at reprocessing plants, solidifying the wastes and placing them in storage at a Federal Repository."

Page 436.

Second complete paragraph. In the comparison of waste heat emitted by nuclear and fossil fueled plants, the hypothetical 1000 MW(e) light water nuclear reactor should not be assumed to be more than 33 percent efficient. Normally, a nuclear plant would emit more waste heat annually than a fossil plant having a similar capacity.

Line 3, change "80%" to "33%"

Line 4, change "5.6 x 10^{12}" to "47 x 10^{12}"

Line 5, change "33.6 x 10^{12}" to "36 x 10^{12}"

Page 436.

In the paragraph which is completed on page 437. The light water reactor should not be assumed to be more than 33 percent efficient. Also, a 1000 MW(e) light water reactor normally requires about 30 metric tons of enriched uranium for its first loading and annual reloadings of about 10 metric tons thereafter.

We also strongly suggest that this paragraph be written to indicate that nuclear power can substitute only for the RFO fraction of crude oil. The nuclear impacts tabulated on Table VIII-1, pp. 455, 6 could then be reduced by about a factor of 10 with a suitable footnote indicating the limited substitutability of nuclear power for crude oil.

Page 437.

First full paragraph, line 4. Delete remainder of sentence after "western States."

Line 5, delete "effects of"

Line 7 and 8, change to read "radioactive tailings cause problems for disposal."

ENCLOSURE 2

THE BNL OIL SPILL TRAJECTORY MODEL

As done in the MIT model, it is assumed in the model that the surface oil moves as the vector sum of the current speed and 3% of the wind speed, i.e.

$$\mathbf{V}_{\text{oil}} = \mathbf{V}_{\text{current}} + .03\ \mathbf{V}_{\text{wind}},$$

and that path of oil in the water column moves with the currents.

The wind can be obtained from observations, or from weather forecasts, but the currents over the New York Bight are not well understood, except that on the average there is a slow drift to the southwest. In the winter, the slow drift is normally dominated by the stronger winds, and in the model it is assumed that they are the major driving force.

The wind acts to accelerate the water through a surface drag and to change the slope of the sea surface to set up a body force known as the "geostrophic" pressure gradient. The rotation of the earth acts to deflect a current to the right in the northern hemisphere (Coriolis force) and this, along with bottom topography, is included in the computer model of the currents.

The currents are computed by using a computer model that is widely used by oceanographers when the water column is of constant density. This situation exists during winter in the New York Bight. The currents then tend to be of the same speed and direction at different depths. The equations that simulate this type of motion are

$$\frac{\partial M}{\partial t} - fN = -gH\frac{\partial \zeta}{\partial x} + \tau^{x} - \tau^{bx} \qquad (1)$$

$$\frac{\partial N}{\partial t} + fM = -gH\frac{\partial \zeta}{\partial y} + \tau^{y} - \tau^{by} \qquad (2)$$

$$\frac{\partial \zeta}{\partial t} + \frac{\partial M}{\partial x} + \frac{\partial N}{\partial y} = 0 \qquad (3)$$

where

$$M = \int_{-H}^{\zeta} u\,dz\ ,\ N = \int_{-H}^{\zeta} v\,dz$$

H = depth (cm)

g = gravity = 986 cm/sec^2

ζ = free surface elevation in cm.

$\tau^{x,y}$ = wind stress in E-W, N-S directions in dynes/cm^2

$\tau^{bx,by}$ = bottom stress in dynes/cm^2

f = Coriolis parameter = 10^{-4} sec^{-1}

The wind stress is computed by the square of the wind speed at the 10 meter level and multiplying by the air density and a drag coefficient, namely

$$\tau_{air} = CD \times \rho_{air} \times V_a^2 \simeq 1.5 \times 10^{-6} \times V_a^2 \qquad (4)$$

and the bottom stress by a similar procedure

$$\tau_{sea} = CD \times \rho_{water} \times V_s^2 \simeq 2 \times 10^{-3} \times V_s^2 \qquad (5)$$

where V_a and V_s are the wind and current speeds in cm/sec, and the τ^x in Eqn. (1) is the vector component of the stress in the x direction, for example. Equations (1) and (2) are momentum equations and the equation for continuity of mass is Equation (3).

The equations are solved using a finite difference technique similar to that of Platzman (1972). The variables are placed on a grid of 65 x 41 points with a spacing ($\Delta x = \Delta y$) of 5.67×10^3 meters.

The depth of the model ocean shelf for New York Bight is shown as a contour plot in Figure 1 where the contours are labelled in meters and the numbers on the axes are the grid point numbers (10 grid points equals 56.7 kilometers).

The complexity and variability of the computed currents is shown in Figures 2-4. Here the land is on the left and the deep ocean is on the lower right, both marked by the letter "c". The length of the vectors is partly proportional to the current speed, the small one meaning 1-5 cm/sec, the middle size meaning 5-15 cm/sec and the large one meaning greater than 15 cm/sec. If the speed is less than 1 cm/sec, a period is placed at that grid point.

The model results for the month of September 1975 were compared against observations taken by Brookhaven National Laboratory off the south shore of Long Island, as shown in Figure 5. The currents were measured at three levels, 4.2 m, 16.5 m, and 29.7 m below the surface. It is only after September 17 that the water density became uniform with depth and that the currents began responding as hypothesized in the model. The model results (plotted on the second line) were computed using the wind stress plotted on the top line. The comparison shows that the model is responding in a realistic manner, although there is a difference of about a day between the model and the observations. It is not known whether this difference is due to the wind stress being different over the shelf than observed at the shore, or to physical forces not included in the model.

With the currents obtained from the computer model and the winds obtained from observations during the period October 1973 through March 1974, the simulated oil spills were moved for each time step with a velocity obtained by linear interpolation according to the position of the spill between the grid points.

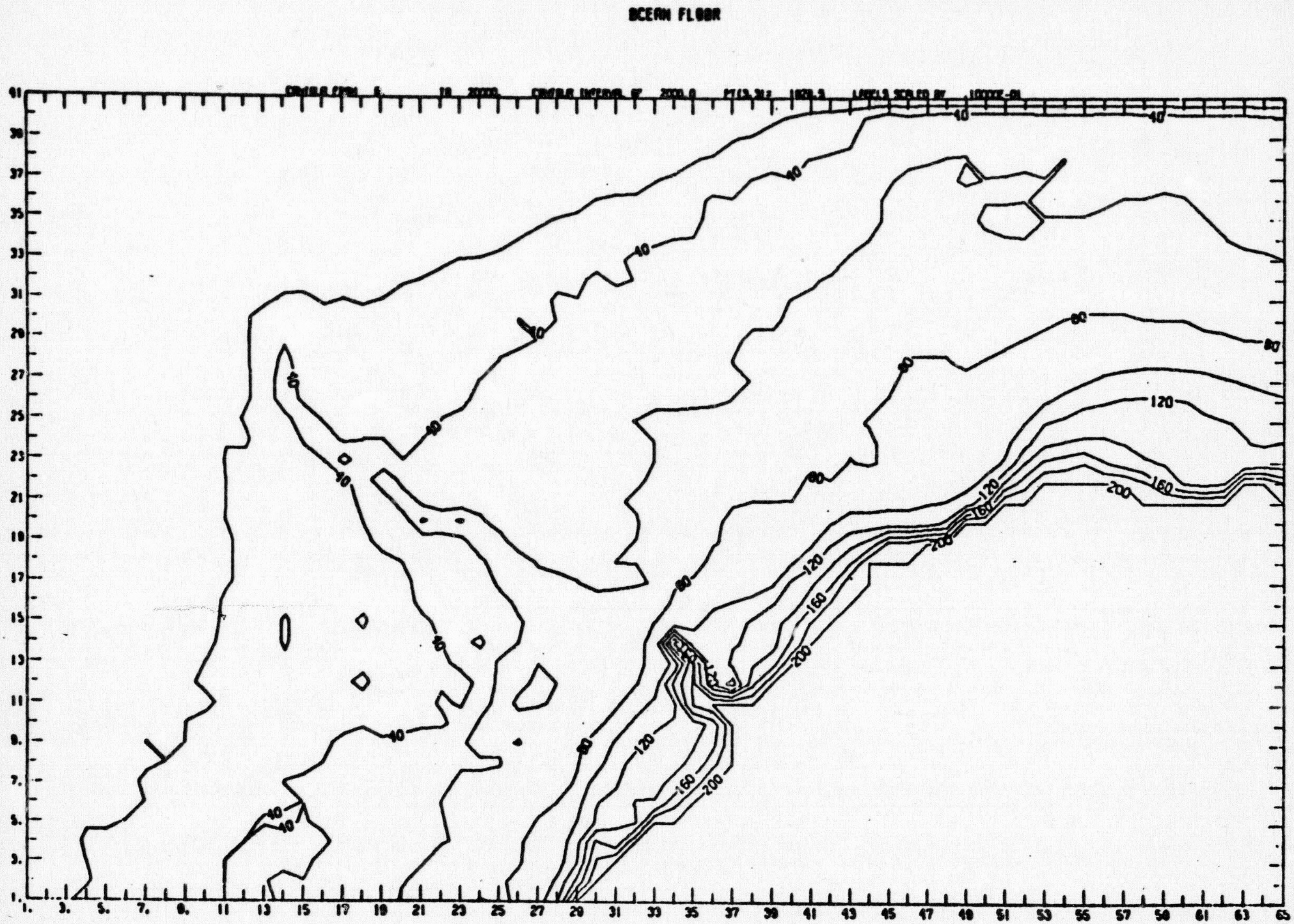
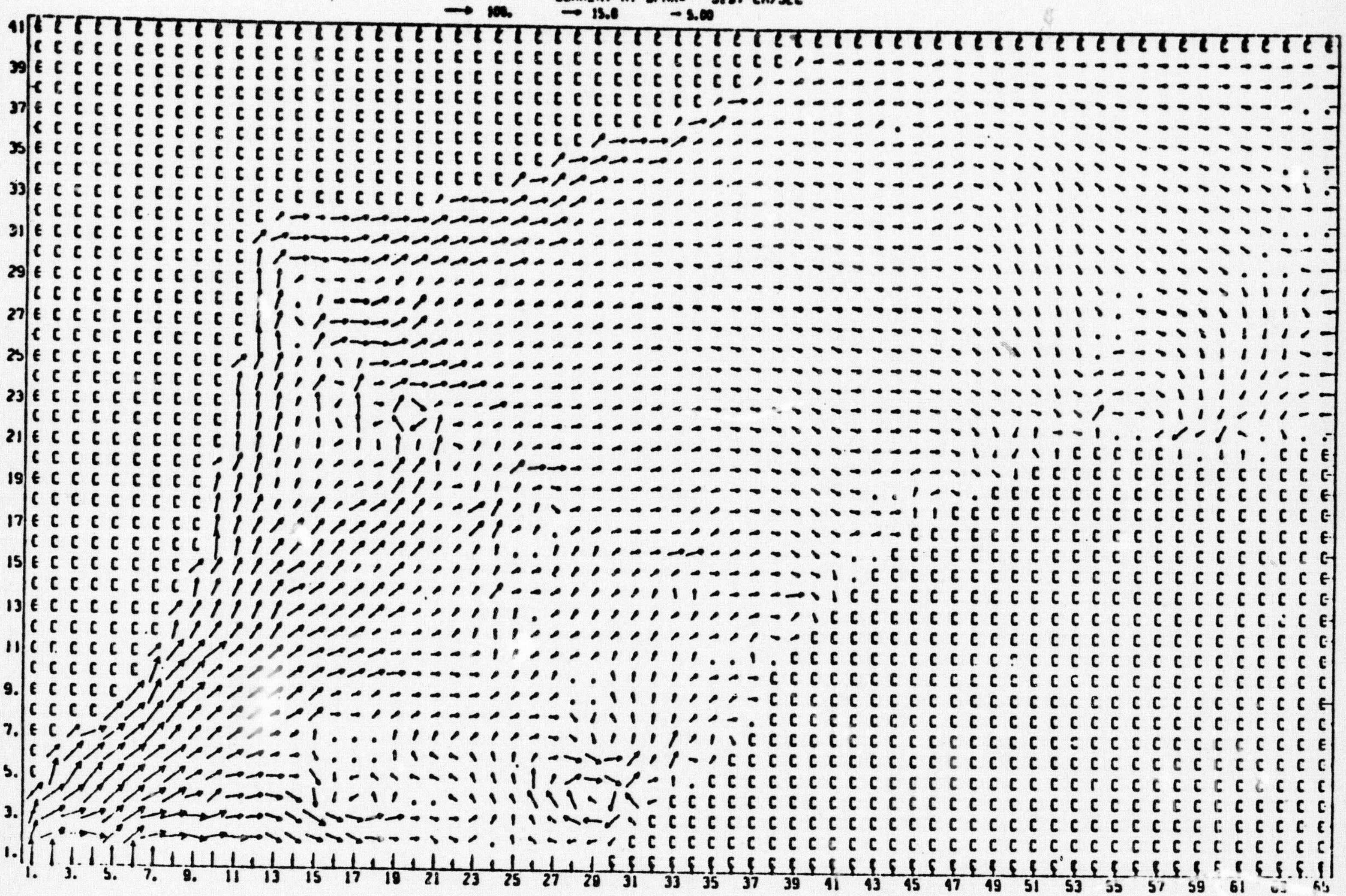
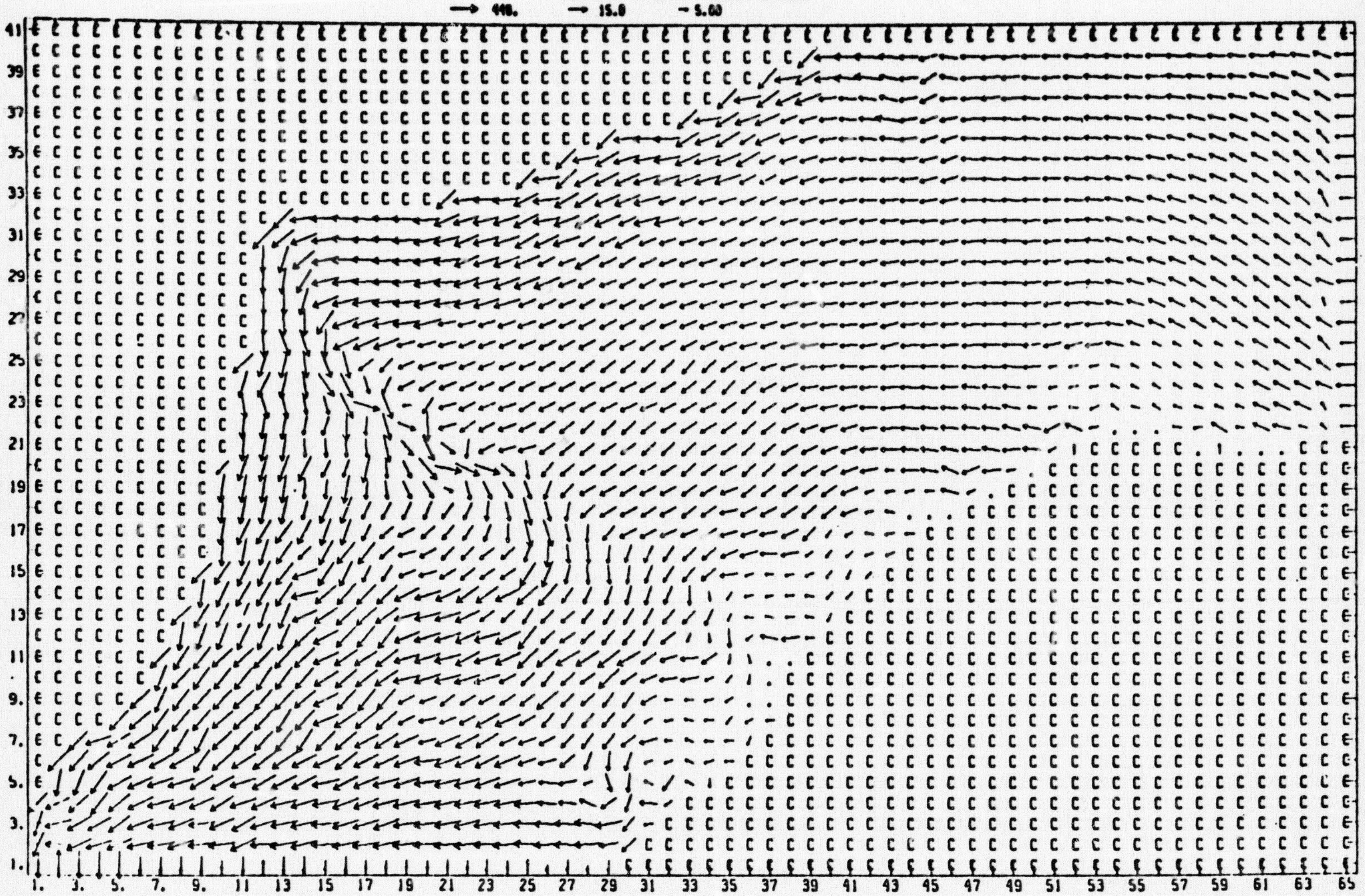

OCEAN FLOOR
CONTOUR FROM 5. TO 20000. CONTOUR INTERVAL OF 2000.0 PT(3,3)= 1829.5 LABELS SCALED BY .10000E-01
40
80
120
160
200
1. 3. 5. 7. 9. 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65
1. 3. 5. 7. 9. 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41

Figure 1. Contour of New York Bight Region.

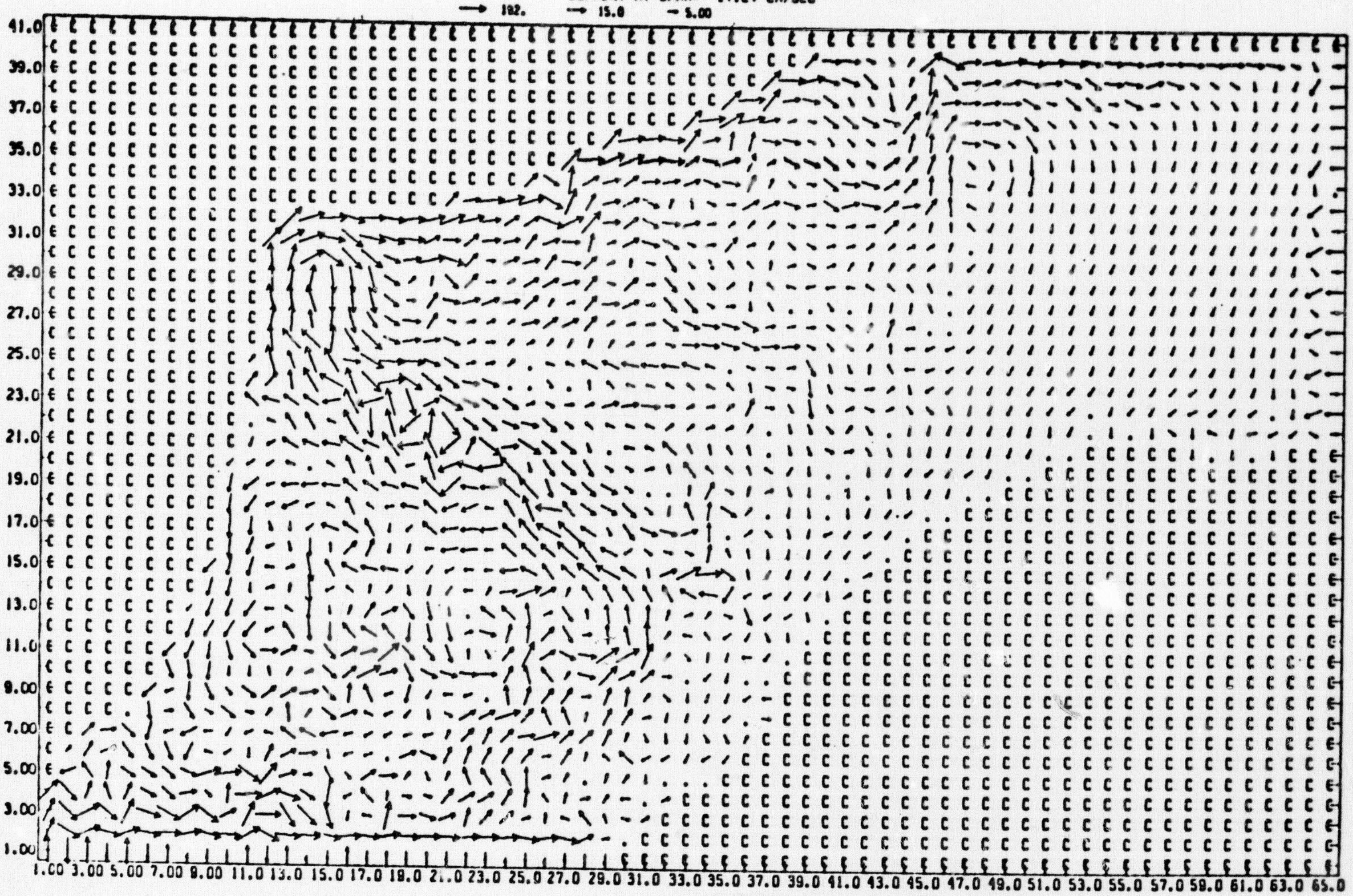
CURRENT AT 6.00 DAYS OR 144.00 HOURS
CURRENT AT SPAR: 5.97 CM/SEC

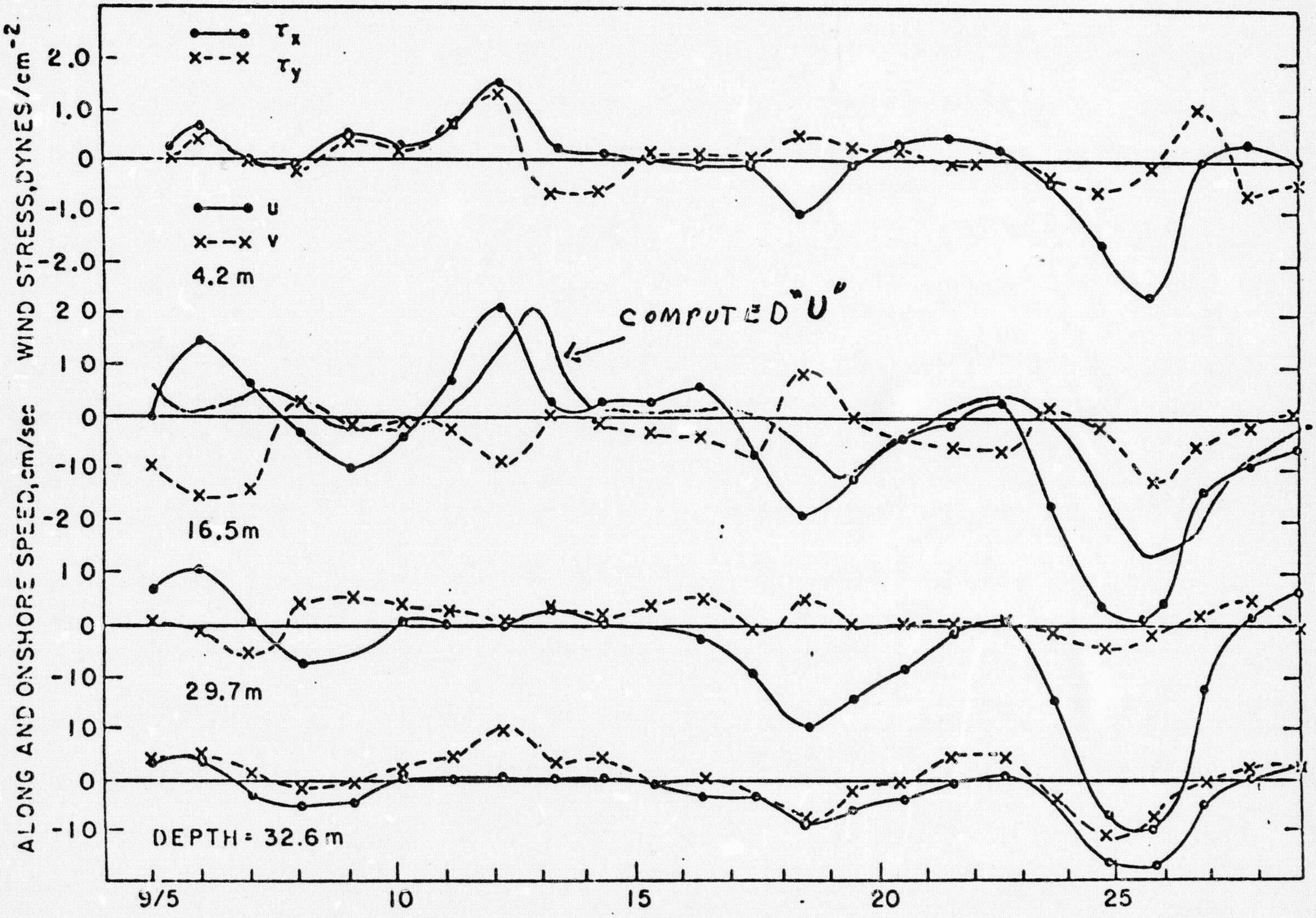


CURRENT AT 24.00 DAYS OR 576.00 HOURS
CURRENT AT SPAR= 30.09 CM/SEC



CURRENT AT SPAR= 17.27 CM/SEC




τ_x
τ_y
u
v
WIND STRESS, DYNES/cm^{-2}
2.0
1.0
0
-1.0
-2.0
4.2 m
COMPUTED "U"
ALONG AND ONSHORE SPEED, cm/sec
20
10
0
-10
-20
16.5m
10
0
-10
29.7m
10
0
-10
DEPTH = 32.6 m
9/5
10
15
20
25

In order to test the model against available observations the simulated spills were released at most of the locations south of Long Island where three groups of drift cards were dropped from the air in the positions Δ on Figure 6 during the winter of 73-74 as reported by Hardy, et al. (1975). Hardy, et al. concluded from their limited data that:

a) releases beyond ten nautical miles of the southern Long Island shore had no chance of hitting the shore within ten days;

b) releases closer to shore had 33% chance, or greater, but if they did not hit within ten days they would not hit at all;

c) there was a trend for the cards to hit the shore eastward of the release positions;

d) areas near Fire Island Inlet and Shinnecock Inlet had a higher probability of being hit than other areas;

e) there were few hits in January and February.

In the computer model a spill was released each 12 hours of the 6-month period from each of the 14 launch points marked by "+" in Figure 7. The probability of a spill reaching the shore from each point is written under the point number. The coast is divided into sections labelled "A" through "I" and the probability of each section being hit out of all the shore hits is written under the letter. It should be noted that sections "F" and "H" have a higher chance of being hit, similar to the observations of Hardy, et al. In addition, 96% of the hits occurred within 6 days and spills beyond 15 miles from the shore had a very small chance of hitting the shore.

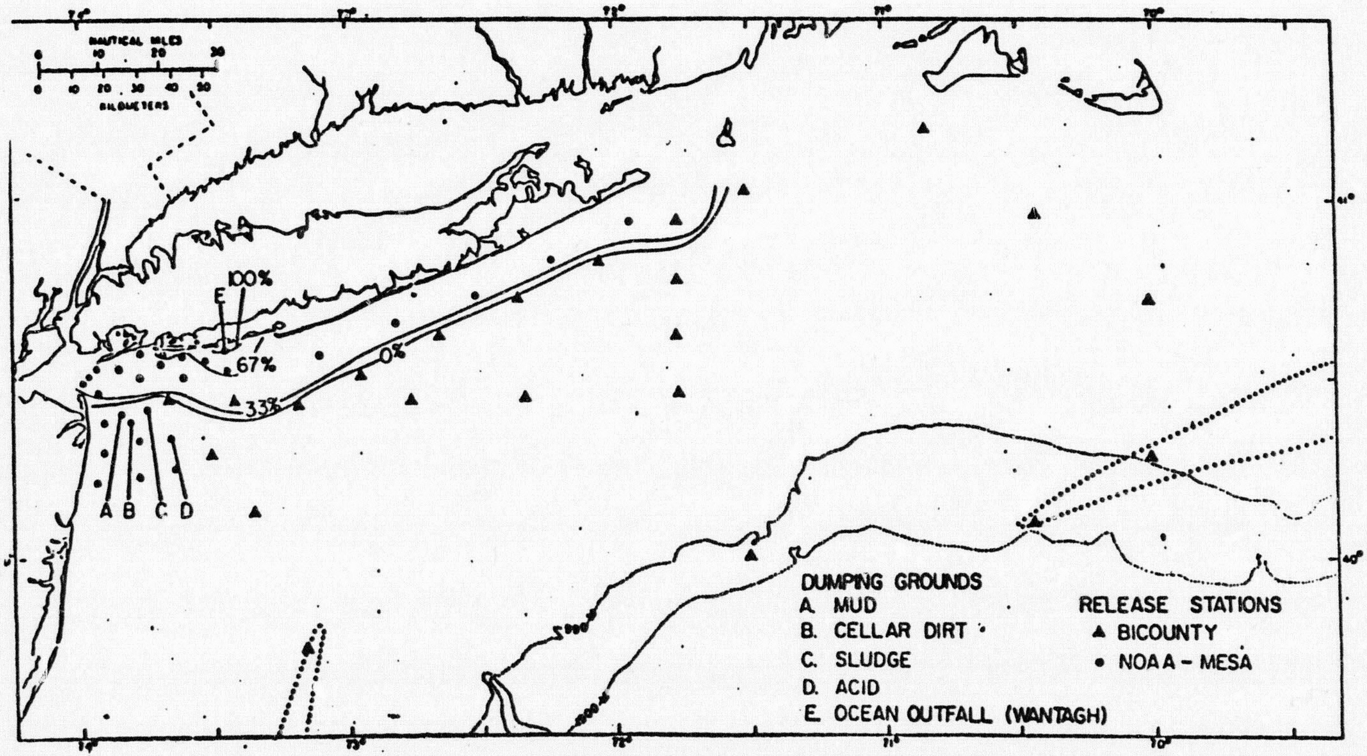
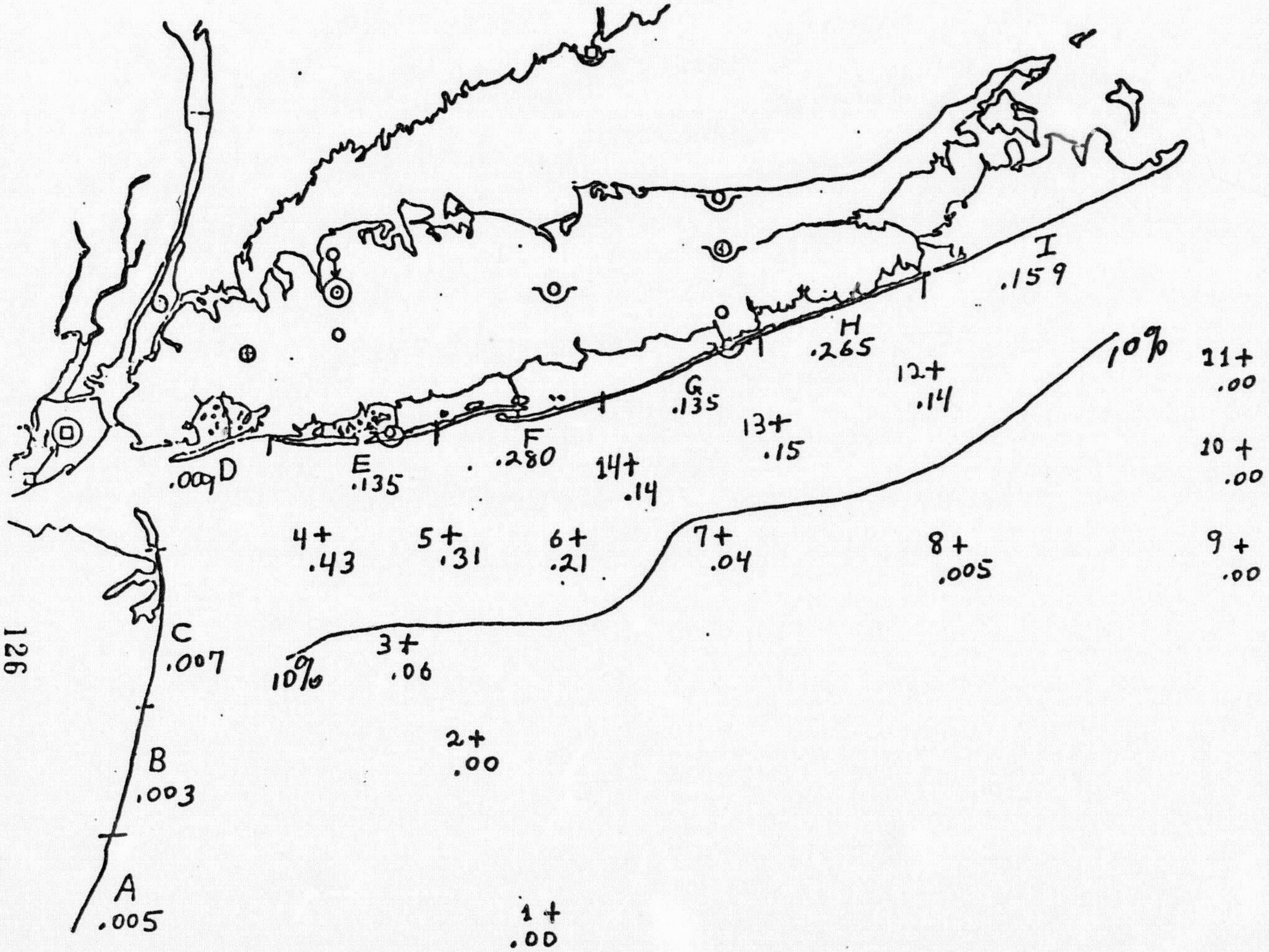

NAUTICAL MILES
0 10 20 30
0 10 20 30 40 50
KILOMETERS
74°
73°
72°
71°
70°
41°
40°
E
100%
67%
33%
0%
A B C D
DUMPING GROUNDS
A. MUD
B. CELLAR DIRT
C. SLUDGE
D. ACID
E. OCEAN OUTFALL (WANTAGH)
RELEASE STATIONS
▲ BICOUNTY
● NOAA - MESA

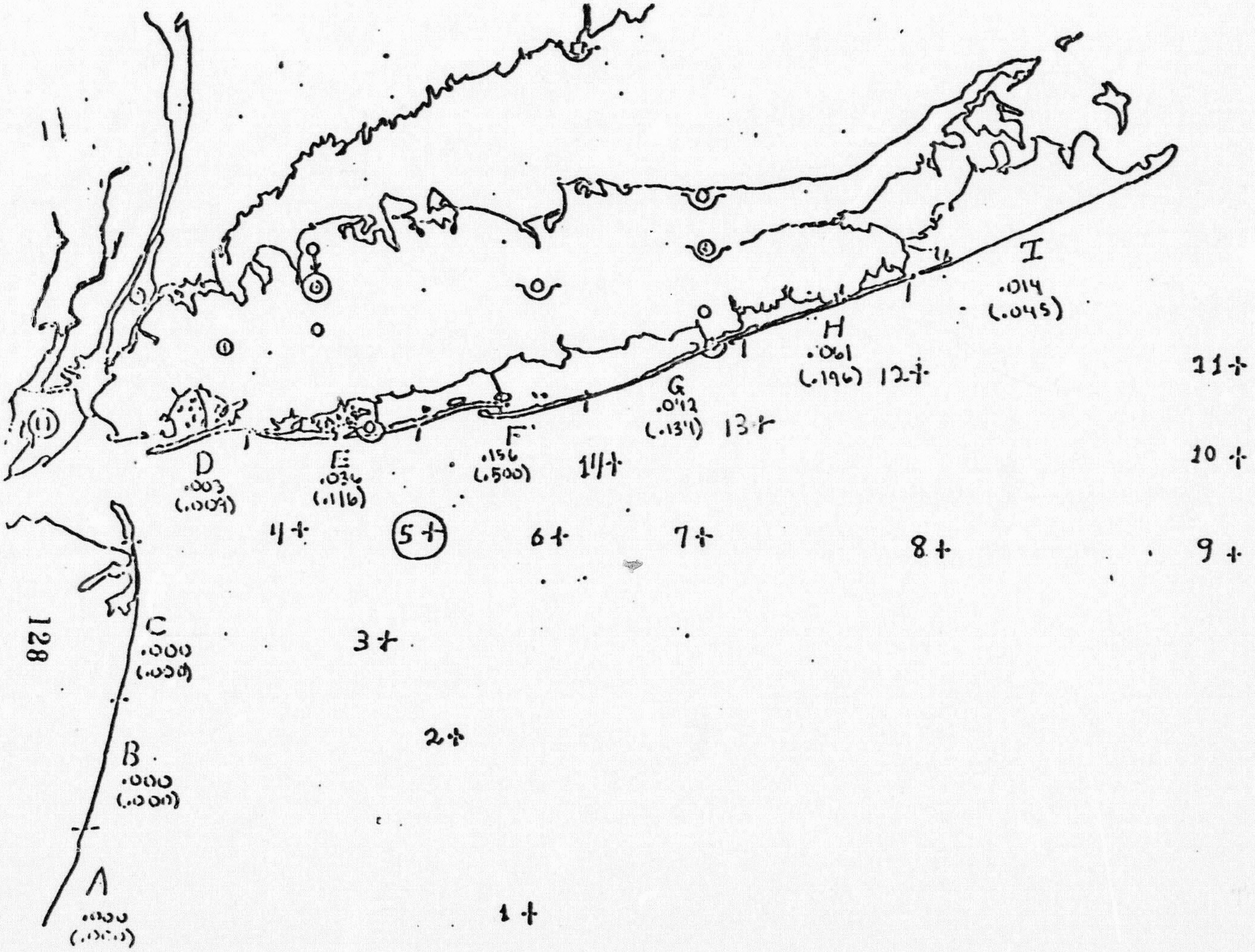
Figure 6 . Per cent Probability Contours that some Fraction of Oil Spills will Strand within 10 Days on Long Island in Winter (January-March) 1974. Based on Interface Drift Card Return Frequencies per Station.
(From Hardy, Baylor, Moskowitz, Robbins, 1975).


I
.159
H
.265
10%
11+
.00
12+
.14
G
.135
13+
.15
F
.280
14+
.14
10+
.00
.009 D
E
.135
4+
.43
5+
.31
6+
.21
7+
.04
8+
.005
9+
.00
C
.007
10%
3+
.06
2+
.00
B
.003
A
.005
1+
.00

The hazard from a particular site can be evaluated, as shown in Figure 8 for release point 5. The number under each letter is the probability of a spill reaching that section during winter and the number in parentheses is the probability that if a spill does reach shore from point 5 it will impact that section.

Other features of the model are illustrated in Figures 9-12. In Figures 9 and 10 the trajectories taken by a spill can be represented for either historical conditions or used in a real-time situation. The source positions are given in latitude and longitude and the numbers along the trajectories are day counters continuing from the starting day. In Figures 11 and 12 the number of shore hits for each 12 hours is plotted against the wind speed and direction for the preceding 12 hours. The vector under the month name represents a west wind of 10 m/sec. There are only a few hits in February as observed by Hardy, et al. With this information, particularly hazardous situations can be analyzed.

The model can be applied to regions on the shelf that are of interest to BLM and the comparison with the field study of drift card releases and current meter observations indicate that it is a valid theoretical approach in analyzing oil spill trajectories.


11
A
.000
(.000)
B
.000
(.000)
C
.000
(.000)
D
.003
(.009)
E
.036
(.116)
F
.156
(.500)
G
.042
(.134)
H
.061
(.196)
I
.014
(.045)
1 +
2 +
3 +
4 +
5 +
6 +
7 +
8 +
9 +
10 +
11 +
12 +
13 +
14 +

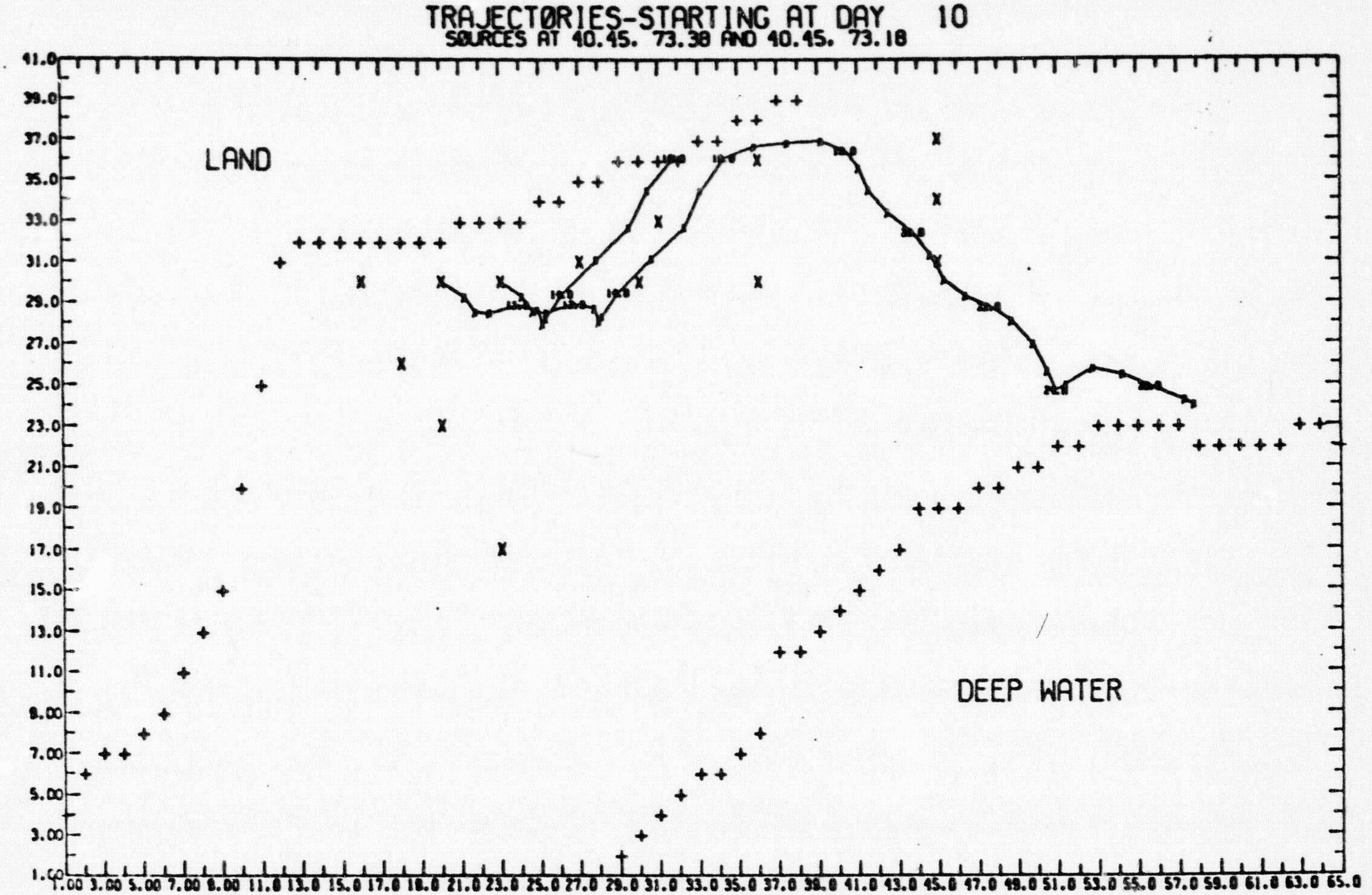

TRAJECTØRIES-STARTING AT DAY 10
SØURCES AT 40.45. 73.38 AND 40.45. 73.18
LAND
DEEP WATER
41.0
39.0
37.0
35.0
33.0
31.0
29.0
27.0
25.0
23.0
21.0
19.0
17.0
15.0
13.0
11.0
9.00
7.00
5.00
3.00
1.00
1.00
3.00
5.00
7.00
9.00
11.0
13.0
15.0
17.0
19.0
21.0
23.0
25.0
27.0
29.0
31.0
33.0
35.0
37.0
39.0
41.0
43.0
45.0
47.0
49.0
51.0
53.0
55.0
57.0
59.0
61.0
63.0
65.0

Figure 9

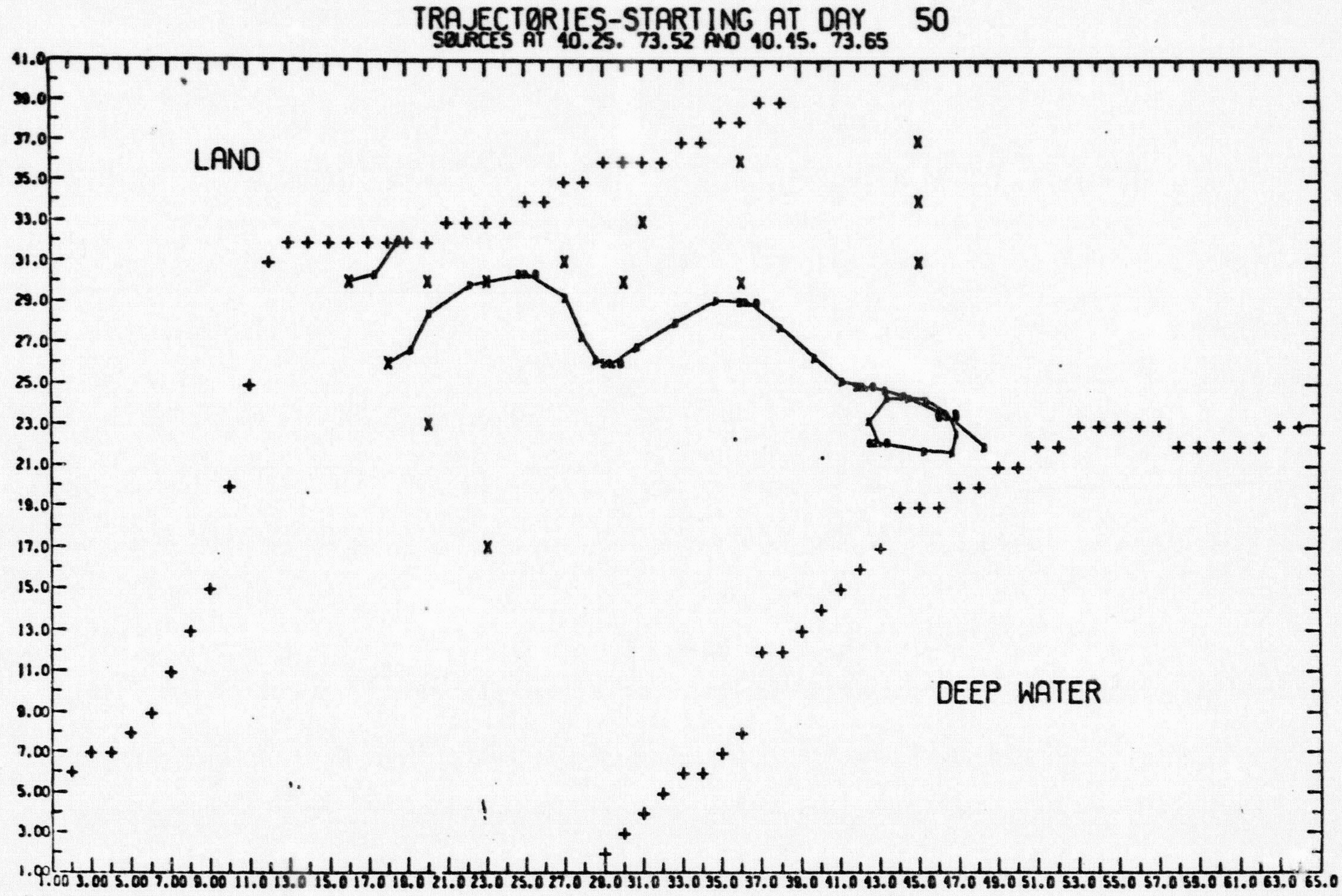

TRAJECTØRIES-STARTING AT DAY 50
SØURCES AT 40.25. 73.52 AND 40.45. 73.65
LAND
DEEP WATER
41.0
39.0
37.0
35.0
33.0
31.0
29.0
27.0
25.0
23.0
21.0
19.0
17.0
15.0
13.0
11.0
9.00
7.00
5.00
3.00
1.00
1.00
3.00
5.00
7.00
9.00
11.0
13.0
15.0
17.0
19.0
21.0
23.0
25.0
27.0
29.0
31.0
33.0
35.0
37.0
39.0
41.0
43.0
45.0
47.0
49.0
51.0
53.0
55.0
57.0
59.0
61.0
63.0
65.0

Figure 10.

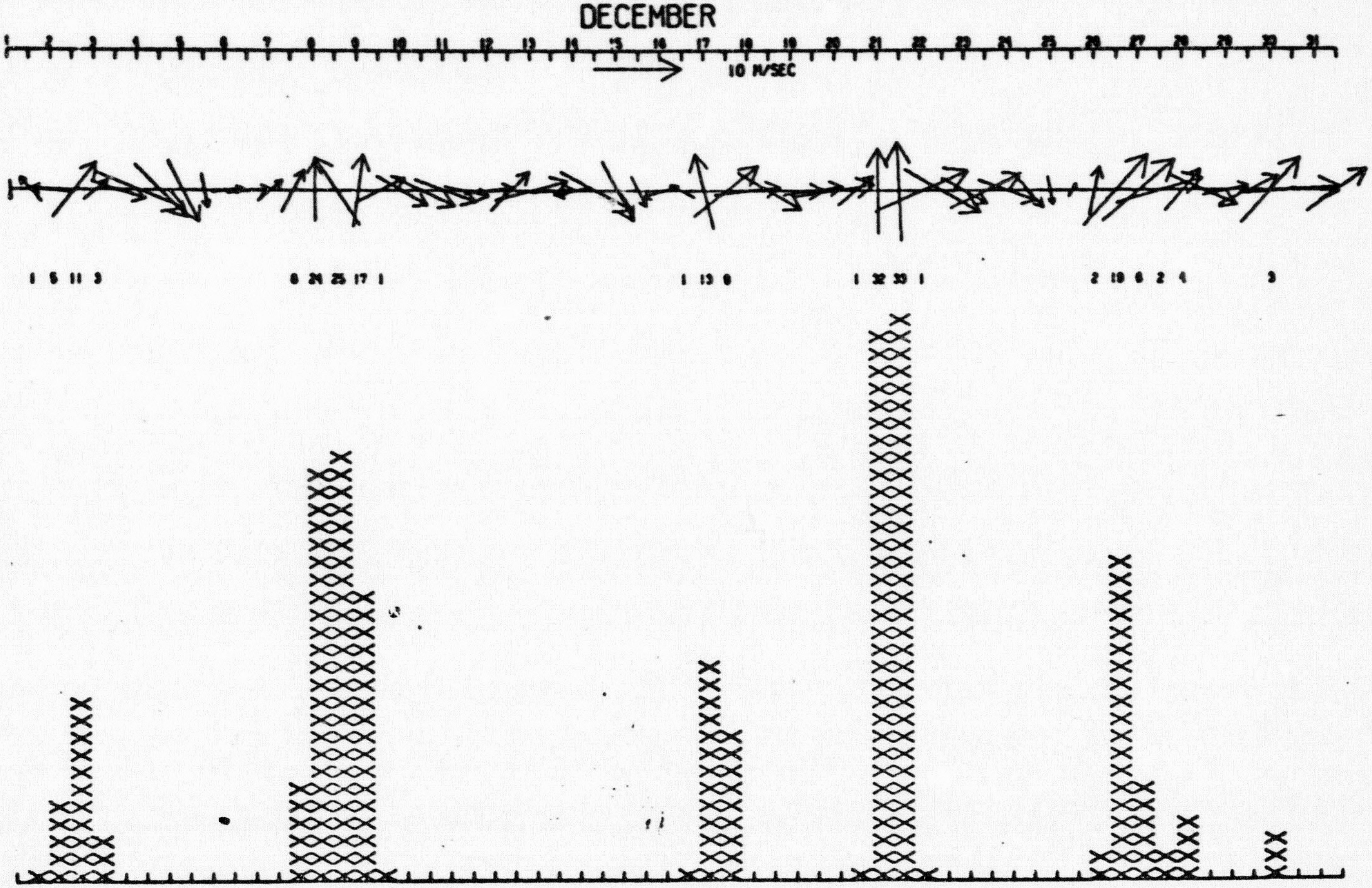

DECEMBER
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
10 M/SEC
1 5 11 3
8 24 25 17 1
1 13 8
1 32 33 1
2 19 6 2 4
3

Figure 11'.

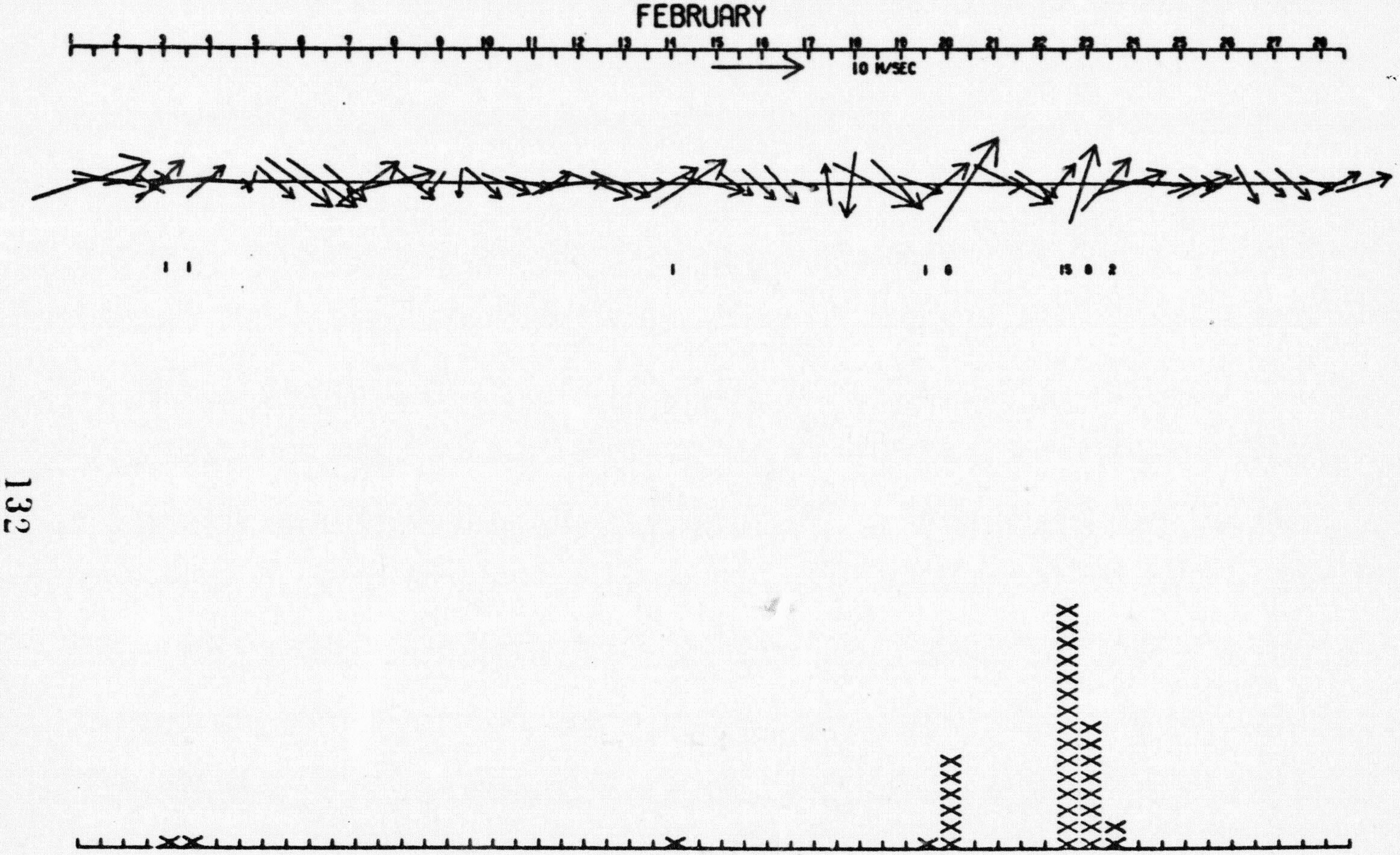

FEBRUARY
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
10 M/SEC
1 1
1
1 6
15 8 2

Figure 12.

References

Hardy, C. D., E. R. Baylor, P. Moskowitz and A. Robbins, 1975. *The Prediction of Oil Spill Movements in the Ocean South of Nassau and Suffolk Counties*. Marine Sciences Research Center at SUNY, Stony Brook, N. Y.

Platzman, G. W., 1972. *Two Dimensional Free Oscillations in Natural Basins*. J. Phys. Oceanography, April.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

DEC 2[illegible] 1975

Department of the Interior
Bureau of Land Management
Director (732)
Washington, D. C. 20240

Dear Sir:

This is in response to your letter of December 10, 1975 inviting our comments on the draft environmental statement concerning the proposed Mid-Atlantic Outer Continental Shelf oil and gas lease sale (OCS Sale No. 40).

We have reviewed the statement and determined that the proposed action has neither radiological health and safety impacts nor will it adversely affect any activities subject to regulation by the Nuclear Regulatory Commission. Accordingly, we have no comments or suggestions to offer.

Thank you for providing us with the opportunity to review this draft environmental impact statement.

Sincerely,

Daniel R. Muller

Daniel R. Muller, Assistant Director
for Environmental Projects
Division of Reactor Licensing

cc: Council on Environmental
Quality (5 copies)

FEDERAL ENERGY ADMINISTRATION
WASHINGTON, D.C. 20461

OFFICE OF THE ASSISTANT ADMINISTRATOR

FEB 13 1976

FEA 75-619

RECEIVED
FEB 1[illegible] 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

Mr. Frank A. Edwards
Assistant Director
Minerals Management
Bureau of Land Management
Department of the Interior
Washington, D.C. 20240

Dear Mr. Edwards:

This is in response to your letter of December 10, 1975, requesting comments on the environmental impact statement for the Proposed OCS Lease Sale #40 (Mid-Atlantic Area). Our comments on the subject are presented below.

General Comment

This is the first sale in the Mid-Atlantic region, and in general, the EIS demonstrates that the sale is not likely to produce unmanageable or unacceptable impacts (on or offshore) for the impacted areas as a whole. Localized environmental problems may arise, but they cannot be identified until the location and magnitude of any hydrocarbon resources have been determined. Accordingly, it is clear that there will be a need for more detailed or site-specific environmental analyses as the developmental process proceeds.

Toward this end, the EIS indicates (p. 321) that OCS development plans will be submitted to the Governors of directly affected States for their information, review, and comment. However, the EIS is not clear as to what environmental analysis will be done pertinent to those development plans, where and when and by whom it will be done, and how the results will be used by the Department of the Interior.

Several approaches to this problem appear feasible. Site-specific or plan-specific analyses could be undertaken by the Department, by State agencies, or on a joint basis. To some extent, coastal zone management planning may serve as a technique for environmental management, and hence coastal zone management plans, once operationalized, could substitute (at least partially) for site- or plan-specific analyses.

Development of appropriate coordination and other arrangements for analysis is vital so that when energy resources are discovered they will be brought into the marketplace without delay caused by misunderstandings between various levels of government. We commend the Department of the Interior on initiatives already undertaken to foster such cooperation. We recommend, however, that the final EIS contain a more detailed discussion of specific intentions or plans for coordination once commercial quantities of oil or gas are proven.

As now planned, the oil and gas reserves of the Mid-Atlantic Coast will be offered in two sales. During review of the Draft, attention focuses on tables presented on pages 16 and 17 of Volume I. These tables present estimated offshore and onshore impacts of the first sale. However, there is no clear reference to the fact that these impacts are not the cumulative effects of all potential development. The failure to provide this reference can lead to misunderstanding. Although a discussion of the cumulative impacts is found in the latter parts of the statement (pages 304-306, Volume II), this discussion can be easily overlooked. It is recommended that these points be clarified in the final EIS.

Specific Comments

1. Page 365 briefly mentions unitized production as a mitigating measure, and refers the reader to the Federal regulations pertinent thereto. Detail concerning the logic of unitization and the extent to which it has been used elsewhere would increase the public's understanding of the significance and utility of unitization as a mitigating measure.

Pages 471-472 have a somewhat broader discussion of unitized development, as an "Alternative Within the Proposed Action." On page 471, unitization is seen as having various advantages, but there is no indication of the degree to which it has been used elsewhere or what the results have been. On page 472, it is held that mandatory "unitization of development could lead to unitization prior to exploration," with adverse effects upon the efficiency of exploration. Has this assertion been tested? If unitization is useful only in particular situations, the range and nature of its utility should be more clearly stated.

2. The following sentence is found on page 366:

> "High resolution geophysical data covering all tracts to be offered for this proposed sale are in the process of being purchased by the Conservation Division of the USGS and will be analyzed by their geophysical personnel."

The ensuing discussion does not make clear whether this analysis will be complete before the lease sale as an input to the tract-selection process.

We appreciate the opportunity to comment upon this interesting project and hope that our comments will be useful to you.

Sincerely,

for Roger W. Sant
Assistant Administrator
Energy Conservation and Environment

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

12 FEB 1976

OFFICE OF THE
ADMINISTRATOR

Mr. Curtis J. Berklund, Director
Bureau of Land Management
U.S. Department of the Interior
Washington, D.C. 20240

Dear Mr. Berklund:

The Environmental Protection Agency, pursuant to its responsibilities under the National Environmental Policy Act and Section 309 of the Clean Air Act, has reviewed the draft environmental impact statement (EIS) for the Proposed 1976 Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States (#40) and our detailed comments and recommendations are enclosed. We believe the Bureau has discussed most aspects of the potential environmental impacts associated with the proposed action, however, there are several issues which we believe require further consideration. Therefore, we have environmental reservations concerning the proposed actions and believe that the statement contains insufficient information (category ER-2 in our system for categorizing EIS comments).

We are concerned that the conflict between heavy vessel traffic in the Mid-Atlantic and the presence of offshore platforms could, in the event of the lease sale, become serious. Five tracts are in the direct path of an existing shipping lane, six other tracts are considered most hazardous to navigation, and thirty-one additional tracts are in conflict with or in close proximity to commonly used shipping routes. Any accidents or collisions involving platforms and vessels, particularly during anticipated storms or fog, could pose a substantial threat of adverse environmental, social, and economic impacts on the shoreline communities where recreational values of wetlands and beaches are high. Considering that adequate technology does not exist for containment of oil on the high seas, there is a probability that oil spills would impact the sensitive shorelines.

RECEIVED
FEB 13 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

In addition to the navigational hazards, the active commercial trawling activities in the Atlantic OCS increase the risk of oil spills by accidental pipeline damages. The uncertainties of the effects of sediment scour, instability of bottom sediments and the heavy storms expected in the Atlantic challenge the structural designs of the platforms. Further, the presence of unexploded ordnance on the sea floor in seven tracts may affect the safety of offshore oil and gas operations.

Because many oil spills and leakages from pipelines and unmanned production sites may be undetected for some time, we recommend that the Department incorporate leak detection and monitoring system requirements in operating orders and encourage development and installation of remote and in situ oil detecting sensor equipment to be deployed around areas of potential oil leakages and spills and other sensitive coastal areas. Furthermore, as a complement to the above monitoring, we recommend that the Department insure aerial surveillance capabilities on the East Coast, to track possible major oil spills and predict their impact areas. Monitoring of the oil movement and prediction of oil impact area by aerial surveillance could provide a valuable basis for mitigating or minimizing the damage of spilled oil.

The onshore impacts of the proposed lease sale could be most significant due to a high population density and the valuable recreational resources and wildlife refuges on the East Coast. However, because of the lack of specificity in the EIS, the onshore impacts of the proposal cannot be fully assessed and evaluated. We recognize that a complete, detailed assessment of the development level impacts may not be possible within this EIS at this stage in the sale process. The sharing of information relating to development plans with affected coastal states as a special requirement of Mid-Atlantic OCS operations may serve to fulfill, in part, this information gap.

We encourage procedures to expedite transmittal of information to the States and preparation of development plans covering both proposed offshore production operations and relative offshore facilities to allow a maximum time period for State review and comment. As an addition to this requirement, we request that as soon as feasible after exploratory results indicate production will be undertaken, the Department prepare an analysis of the cumulative onshore impacts associated with all anticipated development plans in the area. We request that copies of the development plans and analysis be made available to EPA for review.

Finally, as expressed in our comments on the final EIS for the Gulf of Alaska, operating orders are, perhaps, the key to the integration between endemic natural hazards and operational control. We are concerned that the proposed OCS orders for the Mid-Atlantic are essentially a recasting of those for the different environmental setting of the Gulf of Mexico. EPA will soon be transmitting comments on the proposed OCS orders for the Mid-Atlantic area to the Geological Survey. We strongly recommend that the operating orders be finalized and included within the project description of the final EIS.

We appreciate the opportunity to have reviewed this statement and hope that our comments will be of assistance in the preparation of the final statement.

Sincerely yours,

Rebecca W. Hanmer

Rebecca W. Hanmer
Acting Director
Office of Federal Activities

Enclosure

OFFSHORE IMPACTS:

Navigational Hazards

1. We are most concerned about the major hazards to navigation from offshore structures and support vessels with existing heavy vessel traffic in the Atlantic. "The operation of rigs and platforms in the northeastern sector (where eleven tracts are proposed to be leased) would be most hazardous to navigation. . . ." (Vol. 2, p. 123). Twenty-six (26) other tracts in the southern portion of the proposed leasing area which "have traditionally been used by ocean-going vessels, . . . are in direct conflict with this heavy traffic area." (Vol. 2, pp. 123 and 124). There are an additional fifteen tracts which "are of concern because of their close proximity to this area." (Vol. 2, p. 124). These navigationally impacting tracts account for 52 out of 154 proposed tracts and 34 percent of the proposed acreage to be leased. Furthermore, the remainder of the proposed lease areas "are not designated traffic lanes but are heavily used by vessels" (Vol. 1, p. 124). "Ships, especially foreign ships and small craft, do not always use these (designated) traffic lanes which increases the possibility of a collision with drilling rigs, permanent platforms, and/or vessels attending these platforms." (Vol. 2, p. 123).

   "Impacts which could result from collision with offshore structures include loss of human life, spillage of oil, and the release of debris. The contents of a ship's cargo could pose a serious threat to the onshore and marine ecosystems if it includes toxic materials, such as crude oil, refinery products, or other chemicals." (Vol. 2, p. 124).

With the above hazardous navigational conditions given the draft statement has not adequately discussed measures to mitigate the conflict between the offshore oil and gas operations and the heavy vessel traffic other than mentioning the responsibilities of the Coast Guard and the Corps of Engineers and the navigational marking of structures. We strongly suggest that the BLM develop or assure that mitigating measures exist so that such hazardous conditions not occur.

2. Finally, the statement admits that "placement of rigs and platforms within traffic lanes probably will not be allowed." (Vol. 2, p. 123). If the BLM believes such a condition will occur why are five tracts (553, 554, 598, 599, and 643) in the outbound Ambrose to Hudson Canyon traffic lane being proposed to be leased?

Undetonated Explosives

1. The statement indicates on p. 13 of Vol. 1 that because of hazards of unexploded munitions certain tracts were eliminated. However, as shown in the Visual No. 1, undetonated explosive sites are located on seven tracts within the proposed lease tracts. Tracts 812, 769, 770, 771, 813, 857, and 858 are affected. "Appropriate concerns for this proposed sale are the possibility of encountering unexploded ordnance on the sea floor, ... Any accident involving ordnance . . . and petroleum operations could result in oil spills, injuries, or death." (Vol. 2, p. 150). According to the draft statement "the use of magnetometers, as required in the Special Stipulation (Chapter IV) for location of archeological or historical resources, should easily pinpoint unexploded ordnance." However, it does not explain how the unexploded ordnance can be considered archeolo-

gically or historically significant if there are no cultural resources to warrant the Supervisor to place special stipulations on the use of magnetometer to locate such ordnance. Furthermore, the statement does not specify the accuracy of magnetometers when the ordnance is scattered about on the sea floor. If and when such ordnance is located, it is unclear whether the ordnance will be physically removed, the tracts will be withdrawn from sale, or the tracts will be developed anyway away from the detected ordnance. We suggest that these concerns be addressed in the final statement.

Meteorology, and Oceanography

1. In Sections II-B and III-C.7 there is no reference to the CEQ Study, OCS Oil and Gas - An Environmental Assessment in which the Bureau of Land Management and the Geological Survey of the Department of the Interior participated.

2. According to the CEQ Study on OCS Oil and Gas - An Environmental Assessment, Chapter 5 of Volume 1 on Natural Phenomena and OCS Development is based largely upon the results of a study prepared by Tetra-Tech Inc. The figures from the study on comparison of Atlantic OCS to other OCS areas show the Atlantic coast to have the highest maximum sustained wind and significant wave height. Calculations made by NOAA in Section 3.1 of Volume 3 of the CEQ Study justify the severe conditions prevailing on the Atlantic OCS. However, the draft impact statement indicates that the data (Section III.C.7) from Tetra-Tech show winds and waves to be higher in the North Sea than in the Atlantic. A full explanation is needed why such a contradiction in results exists from the same source. Furthermore, there is no reference in the Bibliography

section as to the documentation of Interior's Tetra-Tech data. We believe the interpretation of the data is especially critical because the integrity of the drilling and production platforms is seriously affected by the environmental conditions for which the platforms will be designed.

3. On page 138 of Volume 1 in the last two sentences of the initial paragraph, the wording is such that considerable doubt of the validity of Dr. Dean F. Bumpus's (Woods Hole Oceangraphic Institute) findings may be inferred. Bumpus's finding (that bottom currents have a shoreward-directed component inshore of the 60-70 meter bottom contour, and a seaward-directed component beyond this contour) is significant. This situation may have been overlooked because the slow average flow is masked by large amplitude, continually varying tidal currents and is not clearly revealed by the usual short-term measurement techniques. Bumpus's conclusions are apparently based on a 10-year study involving repeated launching of clusters of sea bed drifters from airplanes over a large grid of stations. Some 12,008 of the 75,485 drifters launched were recovered on the shores of North America and an additional 2106 were recovered by fishermen.

   In summary, we believe that Bumpus's finding deserves to be seriously considered.

4. The percent frequency of occurrence of wind speed by wind direction (wind roses) should be supplied for each station location depicted in Visual 2, by season rather than by year. Also, the persistence of onshore wind directions (NE, E, and SE) in hours or days should be presented for coastal and offshore locations.

Offshore Structures and Design

1. We question the applicability of the Appendix 6-Soil Limitations to the OCS impact statement. The soil limitation descriptions in the Appendix are for foundations and shallow excavations meant for "houses with basements and other buildings with similar foundations requirements." (Vol. 2, p. 604). How is such a soil limitation rating applicable to offshore structural foundations?

2. The CEQ Study states that higher velocity winds and wave heights occur more frequently on the Atlantic OCS than on the North Sea. "This will require that greater design winds be used to achieve the same design objectives as those in use in the North Sea" (CEQ, Vol. 3, p. 13). On page 87, Volume 1 of the draft statement it is mentioned that gravity structures are not now planned and that pile supported templet type structures will be well suited to the Mid-Atlantic OCS conditions. We urge an in-depth discussion be included in the final statement of existing design capability (with examples) of such structures to withstand high wind velocity and wave height expected on the Atlantic OCS, sediment scour and instability known to exist there, and the depth (maximum tract depth of 172.9 meters) to which piles will be driven to the ocean floor.

3. The following statement is attributed to personal communication with Rutledge. "Contrary to the report by Emery and Uchupi (1972) that scour caused the removal of the Texas towers on George's Bank, Rutledge states that they were salvaged because the military radar systems were obsolete, scour never being a problem. Texas Tower #4 (located offshore Long Island) collapsed after a major storm, but Rutledge attributes the failure to damage caused to the structure while being towed from port

(before emplacement); subsequent repair efforts to the damaged support had been unsuccessful." (Vol. 1, p. 89). We suggest that the basis for Rutledge's position be included in the final impact statement.

4. On the Mid-Atlantic OCS "storm waves could transport sediment away from rig or platform legs at these greater depths or could uncover pipelines." "The potential for pipelines to be exposed by sediment transport over a period of years is strong, especially in nearshore areas. Once exposed, a pipeline could rupture due to anchor dragging or trawling activities; this would result in an oil spill." (Vol. 2, p. 114). It is not uncommon that, when trawling the trawl doors which can weigh a ton each, scour along the bottom sediment as much as a foot deep. Since an exposed or partially buried pipeline can be severely damaged by such trawling activities, it is essential that such pipelines are buried to a depth that will preclude interaction with trawling operations. In the final statement we urge inclusion of a technical discussion and analysis of pipeline technology, OCS pipeline laying technology, pipeline burial limitation on varying types of sediments, fail-safe system including metering and sensing devices and valves to detect and limit oil spillage from damaged pipeline, and surveillance equipment and techniques to detect exposed pipelines and to assure sufficient depth of buried pipelines.

5. It is stated in the statement that stubs may be left on the ocean floor until appropriate time to begin production. Although the Special Stipulation will require markers for such stubs, it is unclear from the statement whether such stubs are oil spill-proof against accidental damages from trawl doors and ship anchors. We urge that a discussion be included in the final statement on the technology of stubs.

Formation Waters and Drilling Muds

1. Table III-5 on p. 13 of Vol. 2 lists the chemical content of offshore brines. However, heavy metal concentrations are not mentioned. We believe heavy metal concentrations must be discussed in the final EIS in order to present a better picture of the possible environmental impacts of brine disposal.

2. In addition, the discussion of the effects of the discharge of formation waters on the planktonic community, including the phenomenon of bioaccummulation, should be expanded.

3. The impact statement states that since it is expected that much of the supplies for the initial activity in the proposed Mid-Atlantic area will be brought in from the Gulf of Mexico OCS, ferrochrome lignosulfate in the mud system may be initially used as a result of this proposed action. It is further stated that "the use of chrome and other toxic materials has been avoided in the Pacific OCS area offshore mud systems for several years. Sodium lignosulfonate has replaced ferrochrome lignosulfonate in a majority of this area's offshore mud system." (Vol. 2, p. 7).

   The potential or actual adverse environmental effects of heavy metal discharge into the marine communities cannot be ignored particularly in the area where commercial fishing resources are important. As the Department is aware, these discharges are subject to restrictions included in NPDES or ocean dumping permits issued by EPA, and EPA may place restrictions on the discharges of heavy metals.

Spill Prevention and Cleanup

1. The statement does not discuss shoreline cleanup technology and associated impacts of cleanup nor does it discuss the availability of equipment. We suggest that such information be included in the final statement.

2. The effectiveness of offshore cleanup depends upon weather and ocean conditions. The oil containment equipment which is now available as well as that which will be built in the near future cannot effectively operate in high winds and waves expected in the Mid-Atlantic OCS. Thus, we urge the Department to encourage development of oil spill contingency plans by lessees to mitigate oil spills on the high seas by other means and to prevent oil from reaching biologically and recreationally valuable shorelines.

Monitoring and Surveillance

1. To facilitate detection of oil leakage along pipelines, we recommend that Operating Order #9 contain a requirement for a leak detection and monitoring system, based on pressure sensing, metering and volume balance parameters similar to that developed for the Trans Alaska Pipeline. Such a system is technologically feasible.

2. We recommend that the Department insure in the event of a significant oil spill that capabilities exist for aerial surveillance, including for example, remote sensing and aerial mapping to locate, tract, and predict the movement of the spilled oil and the ultimate impact area of the coastal shoreline.

3. Because of possible insensitivity of measuring and sensor devices on unmanned production platform, oil leakage or spills may be undetected for some time. We recommend that DOI encourage development and installation of remote and in situ oil detecting sensor equipment around offshore platforms, and other sensitive areas along the coastal shore for early detection of, and mitigating action for, spilled oil.

Other Comments

1. Appendix 10-Matrix Table indicates that the closest tract is 54 miles from shore. The final statement should clarify that the minimum time required for oil spill emanating from a tract closest to the shore to impact the shoreline is less than 46 days. (Our rough calculation shows 34 days.) The 46 day minimum is from ED 6 or ED 7 used in the MIT model which are 69 miles and 78 miles, respectively, from the nearest point on shore.

2. The descriptions of tracts 587-591, 596-599 are missing from the Matrix Table.

3. Much of the section on ocean dumping (Vol. 1, pp. 481-495) contains information derived from an unpublished report by Mueller and Jeris. These authors, in describing dump sites, are quoting an earlier report prepared by Interstate Electronics Corp for EPA (Ocean Waste Disposal in Selected Geographic Areas, 1973). Their discussion on dump sites is based on the operation and management as accomplished under the Corps of Engineers. Many changes were made when EPA assumed management of these dump sites in April 1973, and thus, the discussion is out of date.

We would be glad to meet with the appropriate BLM staff to discuss numerous, specific corrections and provide updated material for the ocean dumping section.

4. The statement mentions in p. 92, Vol. 2 that a possible source of impact during pipeline dredging is the resuspension of toxic heavy metals and pesticides primarily associated with dump sites and various outfalls areas. We recommend that the best possible way to mitigate against these impacts is simply to avoid these areas, and we suggest that DOI institute appropriate procedures.

ONSHORE IMPACTS:

Development Plan

1. An alternative within the proposed action discussed in the statement (Vol. 2, pp. 466-469) provides suspension of operation between the exploration and development phases of potential lease operation. This alternative is available to the Secretary of the Interior to allow directly affected States an opportunity to review and comment on the development plans required to be submitted to the U.S. Geological Survey by the offshore operators.

   We fully support the intent of this alternative to give the Department, affected States and other agencies such as EPA a full opportunity to evaluate the development impacts and means for controlling any adverse effects. Whether a formal suspension is needed may be a function of how well the process of formulating development plans is integrated with the need for Federal and State environmental reviewing and how complete is the information required to be provided by the operator.

We encourage procedures to expedite transmittal of information to the States and preparation of development plans covering both proposed offshore production operations and relative offshore facilities to allow a maximum time period for State review and comment. As an addition to this requirement, we request that as soon as feasible after exploratory results indicate production will be undertaken, the Department prepare an analysis of the cumulative onshore impacts associated with all anticipated development plans in the area. We request that copies of the development plans and analysis be made available to EPA for review.

Wetlands

1. In assessing the natural resources to be affected by the OCS sale, the EIS gives special mention to the wetland's importance as an ecosystem that contributes energy to adjacent biotic domains. However, out of the twenty-four pages used to describe the impacts of oil and gas operations on the natural environment, none were devoted to wetland effects. There is certainly sufficient scientific literature and knowledge on this resource to merit a discussion on this ecosystem. This oversight should be corrected in the final EIS.

2. It is stated and intimated in numerous places in the EIS that the major factor to be considered in pipeline routing will be shortest distance (p. 175, Vol. 2 for example). For OCS Sale #40 the landfall, which is closest to the geographical center of the 154 tracts, is perhaps the most environmentally sensitive in New Jersey, consisting of Island Beach State Park, the Brigatine National Wildlife Refuge, the Tucerton Marsh, Barnegat Bay National Wildlife Refuge, various barrier beaches (such

as Long Beach Island), and the cleanest major river system in the State, the Mullica River.

It is of great importance that the Bureau not accept the premise that the shortest, cheapest, pipeline route is the best, particularly since terminals, storage facilities, gas processing plants, and support facilities will likely be sited according to pipeline routing. To the maximum extent possible, major facilities should be located outside the areas such as those cited above. We suggest that the Bureau contact the affected States to determine their plans for protecting and restoring areas and assure the consideration of the coastal plans in the siting of major facilities.

3. On p. 219, Vol. 2 land use requirements of OCS-related facilities are given. Many facilities require inland water docksites with ocean access. We again emphasize that inland waters such as the Mullica, Wading, and Great Egg Harbor rivers should be avoided, and that State plans be considered in the siting of these facilities.

4. On pgs. 218-220, Vol. 2 it is mentioned that between 70 to 265 acres might be required for OCS-related facilities development in coastal areas. We believe that this is a considerable underestimation of the land requirements. For one, the estimate does not include pipeline right-of-way. From landfall inland, a pipeline could traverse 20 miles of the coastal zone. Given 50 feet right-of-way, this translates to about 115 acres, an increase of almost 50% (for only one pipeline) over the figure estimated in the EIS.

5. Pipeline burials across barrier beaches are discussed in the EIS. We recommend that barrier islands not be beached unless it is absolutely

necessary. A disruption of the barrier beaches would threaten the development and protection of the extensive and valuable tidal marshes landward of the beaches.

Parklands

1. Visual #1 does not identify all Federal and state open space and recreation areas in the most affected region. For example, the Holgate section of the Brigentine National Wildlife Refuge, on the southern tip of Long Beach Island, is not listed. Also, virtually the entire expanse of the Tuckerton marsh is under public ownership. In additon, nearly the entire mouth of the Mullica River is surrounded by public lands.

   Inland resources such as the Wharton Tract and Bass River State Forest should be included in the visual. The Wharton Tract, for example, is the largest piece of public land in the State and is immediately adjacent to the coastal areas most likely be impacted by the action. Municipally operated public lands should be shown also on Visual #1. This would greatly increase the amount of coastline shown to be under ownership. Such information would be valuable in assessing the potential impacts of OCS development.

Groundwater

Groundwater contamination is given as an inevitable consequence of development. It should be pointed out that the entire South-Central area of New Jersey, the region which will be most likely heavily impacted, is underlain by the Cohansey aquifer. This aquifer holds water much in excess of a lake 1000 square miles in surface area and 15 ft. deep, and has often been mentioned in the context of an almost unlimited pure water supply for the State. Extensive contamination of the aquifer by domestic and industrial spills and wastes would be most unfortunate, and provides another urgent reason for thoughtful siting of oil and gas related facilities. It should be noted that EPA is preparing regulations for State underground injection control programs pursuant to the Safe Drinking Water Act (P.L. 93-523) and that the potential contamination of underground water resources may be subject to State requirements.

Other Comments

1. Since the New York State now administers its own NPDES permit programs, correction should be made on p. 42 of Vol. 1.

2. The Interstate Sanitation Commission should be referenced in the section Other Planning Mechanisms, p. 45 of Vol. 1.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WALLOPS FLIGHT CENTER
WALLOPS ISLAND, VIRGINIA 23337

REPLY TO ATTN OF: DA(A-19)

APR 2 1976

Ms. Judith B. Gresham
U. S. Department of the Interior
Bureau of Land Management
New York Outer Continental Shelf Office
6 World Trade Center, Suite 600D
New York, NY 10048

Dear Ms. Gresham:

Wallops Flight Center personnel have reviewed the Draft Environmental Statement for the Proposed 1976 Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States and have no comments for inclusion. Thank you for the opportunity to review and comment on the proposed sale.

Sincerely,

Joseph E Robbins

Joseph E. Robbins
Director of Administration

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

OFFICE OF THE DIRECTOR

JAN [illegible] 1976

Memorandum

To: Director, Bureau of Land Management

Through: Deputy Assistant Secretary--Energy and Minerals Rollant R Reed

FEB 2 - 1976

From: Acting Director, Geological Survey

Subject: Review of draft environmental statement for OCS Sale No. 40, Offshore The Mid-Atlantic States

We have reviewed the subject draft environmental statement as requested in your memorandum of December 10.

We regard this draft environmental statement as one of the better ones prepared to date for oil and gas development in a frontier area. The document is generally accurate with respect to technical aspects of oil and gas operations. The discussion of potential environmental impacts of these operations is generally well researched and reasonable.

Volume 1

Page 1 - It is stated that "the undiscovered recoverable resources of the 154 tracts included in the proposed lease sale area range from 0.4 to 1.4 billion barrels of oil and 2.6 to 9.4 trillion cubic feet of gas." However, it is stated on the first page of volume 2 that "As previously indicated, a total of 154 tracts are proposed to be leased... The amounts of undiscovered recoverable resources estimated by the USGS, based on proprietary geophysical data, are 0.4 to 2.6 billion barrels of oil and 2.6 to 12.8 trillion cubic feet of gas." Although the basis for the estimates is given in footnotes, the two general statements quoted above should be made consistent. Moreover, the use of the larger figures appears questionable, because a footnote on page 1 of volume 2 explains that these are for an assumed lease area of two million acres, while the area presently proposed for offering is only 876,750 acres. In addition, it is estimated that only 523,756 acres would actually be leased. The larger figures in question also appear on pages 22 and 28 in volume 2.

RECEIVED
FEB 3 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

Page 18, paragraph 2 - The environmental statement recognizes the need for environmental baseline studies for the Mid-Atlantic area. However, additional onshore baseline data on water-quality characteristics and hydrologic characteristics, especially regarding estuarine rivers and bays and beach environments, also should be considered. Such data is needed to assess any effects that may result from offshore sources of pollution on the onshore hydrologic system.

Page 49, paragraph 2, line 4 - "These Coastal Plain sediments rest up against..." should be changed to "These Coastal Plain sediments are deposited over..."

Page 52, paragraph 2, line 4 - It is stated that "Behind the (basement) ridge an evaporite basin was formed and anhydrite, dolomite and limestone were probably deposited." We stress that up to the present no evidence exists to substantiate the presence of an "evaporite basin" or the presence of evaporitic sediments such as salt, anhydrite or gypsum. The intrusive-like features that have been detected geophysically might well have been formed by any of a number of other geologic mechanisms. Additionally, color Visual No. 3 of volume III shows structural features such as "salt domes (?)," "igneous basement intrusions (?)," and a "basement ridge." Such features are not appropriate to the title of the Visual: "Soil Limitations for Foundations and Shallow Excavations."

Page 53, last paragraph - Clarification needed. Define structural and stratigraphic traps.

Page 55, line 11 - The arching of sediments noted by Sheridan offshore of Delaware may not have necessarily been caused by an igneous intrusion or salt diapir. Draping over a buried reef structure may very well have caused the arching.

Page 55, line 20 - This sentence should read: "Well data from the Coastal Plain indicates that there is a general tendency for Lower Cretaceous and Jurassic sediments to pinch out in the updip direction."

Page 56 - The source of figure II-3 has been omitted.

Page 57, line 2 - Suggest changing this sentence to read: "To date no production has taken place on the Atlantic Coastal Plain or Outer Continental Shelf but discoveries have been made on Canada's Scotian Shelf." As the sentence now reads, it implies production (on line) has started on the Scotian Shelf. This is not so.

Page 57, line 8 - Suggest changing this sentence to read: "Although this may represent the nearest analog to the Baltimore Canyon trough in terms of location on an Atlantic type margin, ..." On the Scotian Shelf all discoveries so far have been associated with salt diapirs. We don't know whether any such diapirs exist in the Mid-Atlantic.

Page 66, paragraph 1, lines 4 and 5 - Capitalize Embayment and Arch.

Page 70, figure II-11 - Source omitted.

Page 74, figure II-13 - Source omitted.

Page 75 - Specific information on the engineering properties of soils should be given. It is true that many adverse soil conditions in the Mid-Atlantic states have been accommodated by proper design, but many have not. Areas of wetland soils, plastic clay, and saprolitic soils are quite common in the Mid-Atlantic and require critical design techniques to accommodate potential hazards.

Page 77, figure II-14 - Source omitted.

Page 83, Seismic - Suggest adding reference to Frank Press, 1975, Earthquake Prediction: Scientific American, May. Although the conclusions are not contradicted in this paper, Press's article is the latest and he is one of the leading authorities in the field of earthquake prediction.

Page 84 - The statement on seismic activity in the OCS is misleading; the potential for seismic activity in the Mid-Atlantic is not less than that of the Gulf of Mexico area.

Pages 83-94 - The section on "Potential Geologic Hazards" does not mention the possibility of structurally weak clays being encountered in setting rigs and structures on the bottom. Also, it does not mention the possibility of encountering cavernous limestones in the carbonate sections. Such limestones often cause loss of mud circulation and pressure, and sometimes cause the loss of drilling tools. Hydrogen sulfide gas zones are also encountered in carbonate rocks, and if protective measures are not taken by drilling crews, this gas could be lethal to rig personnel.

Page 87, paragraph 4, line 1 - The statement is made that "Since gravity structures are not now planned for use in the Mid-Atlantic, the associated engineering problems will not be discussed." It is our opinion that it would be useful to discuss why these structures are not being planned for use, along with a brief explanation of some of the engineering problems that accompany the use of these structures.

Page 129, figure II-28 - This figure should be titled "Mean Sea Surface Isotherms, January-April," rather than "May-August."

Pages 212-319 - Although a noteworthy effort has been made to define the various biological communities that exist in the Mid-Atlantic States OCS area, it is our opinion that the heavy reliance on use of taxonomic names seriously impairs the value of the descriptions contained in this section. It is doubtful that concerned private citizens or most state and Federal administrators having interests concerning potential oil and gas development on the Atlantic OCS would be able to understand much information contained in the section as it is presently written. It would be too much to ask that the entire section be written using the common names of species. We believe it is necessary, however, to use the common names of familiar species, and the names of economically important species in particular. In some portions of the text, it would be very helpful if some definitions of the various major groups and common species were included. Generally, the text from page 213 to page 272 is impaired as a result of the general disregard for common names and group definitions.

Pages 273-298 - The sections on fish and marine mammals use the common names of species, and are generally much more readable than the preceding section with its biological descriptions.

Pages 299-313 - The section on vegetation again relies too heavily on taxonomic names (see comment on pages 212-319).

Page 558, paragraph 3 (also vol. 2, p. 404 and 462) - Reference is made to nearshore stratigraphic oil and gas trap possibilities as an alternative to leasing the area currently designated for Sale No. 40. The text fails to mention that because there is no geological or geophysical method of accurately defining stratigraphic traps, the government would be unable to offer the most prospective tracts and generate minimum acceptable bids for the tracts. There have been several hundred wells drilled on the Atlantic Coastal Plain and in coastal waters of some of the states with no indication of hydrocarbons detected. This tends to greatly minimize the chances of gauging industry support to a nearshore sale, or for that matter, a sale of any tract other than those which have been selected for Sale No. 40. Moreover, the draft statement in general should make a stronger point, if it has been made at all, that the sale is based on industry nominations. If tracts that industry is interested in are not put up for bidding, then industry will not bid and there will be no oil and gas development on the Atlantic OCS.

Volume 2

Page 2, lines 7 through 11 - "In some areas where 'shows' have..." we suggest this rewording:

> In some areas where "shows" have occurred, drilling has continued for over five years before discovery, resulting in several wildcat wells per tract. The average number of wells for those tracts drilled can vary from one to seven or eight. The average number of wells, however, for the tracts leased will be considerably less, or an average of one well or less per tract leased.

Page 3, paragraph 2, line 9 - Drill cuttings and muds which are discharged must not contain any "free oil." The 48 ppm standard is applicable to formation water discharges (BPCT).

Page 4, table III-1 - The volume of cuttings for the 0-900 foot interval should be 597 barrels, not 297. This is apparently a typographical error since the total volume of cuttings for the well is correct.

Page 4, line 6 - The text states that 90 percent of drilling muds would be recycled for use in other wells. Although this would be true for drilling production wells, this would not be the case for exploratory wells. Recycling drilling muds in various exploratory wells would result in contamination of drill samples, thereby impairing their informational value.

Page 6, table III-3, column 2, Interval - Total should be 20,500 rather than 20,550.

Page 7, paragraph 2 - Ferrochrome lignosulfonate serves as a highly efficient dispersant by reducing the attractive forces between clay particles. Chrome lignosulfonates prevent the swelling and viscosity development of bentonite more effectively than other thinners. Because of their effectiveness, chrome lignosulfonate muds are used in the Pacific OCS and throughout the world. Operators will be using this type of mud in the Mid-Atlantic, not because they are duplicating Gulf Coast practices, but because drilling muds are vital for well-control purposes and chrome lignosulfonate allows these muds to carry out these well-control functions in deep holes.

Page 9, footnote 1 - It should be noted that two platforms for 1,000 feet of water are being constructed for Shell Oil Company for use in the Gulf of Mexico.

Page 14, paragraph 2 - The EPA-BAT standards are to be achieved not later than July 1, 1983. However, these standards also apply to all new discharge sources. The applicable standard for all Mid-Atlantic production facilities would, therefore, be the BAT standard or an average oil content of 30 ppm.

Page 15, paragraph 1 - Primary water production varies from 20 percent to 150 percent of the oil production volume. The maximum water-oil ratios do not occur during the periods of peak production but toward the end of the reservoir's productive life. The ultimate W/O ratio will also be dependent upon economic conditions. The estimated peak production for the sale area is 90-320 thousand BOPD. A reasonable peak water-production estimate would be 300 thousand barrels per day or less.

Page 15, last sentence - EPA sewage discharge requirements specify only that the effluent have a minimum chlorine residual of 1.0 mg/l. The BOD and suspended solids discharge criteria reported in this sentence are currently required by OCS Order No. 8. However, USGS sewage discharge requirements for the Mid-Atlantic and other OCS areas will be modified to conform to the EPA standards.

Page 16 - It is stated that "It is anticipated that all oil and gas produced as a result of this proposed sale will be transported to shore by pipeline." However, it was stated in volume 1 that "production is expected to be transported to shore via pipelines ... It is also possible that some production could be transported to shore via tankers" (p. 15, par. 1). The statement on page 16 evidently should be qualified, because two pages later it is stated that "tankers may be used" (vol. 2, p. 18, par. 2).

Page 18, line 3 - The text states that the Interior Department has no jurisdiction over pipelines in state waters. It should be mentioned here that the Office of Pipeline Safety under the Department of Transportation has published a Notice of Establishment of Standards for Offshore Pipeline Facilities (49 CFR, Part 195) in the Federal Register, September 23, 1975.

Page 19, paragraph 3 - There are no data to support the contention that heavier seas and more difficult winter conditions increase the probability of oil spills. Operating equipment and personnel programs are designed to meet the needs of harsh weather environments. Due to the expense of the equipment and the rigors of the environment, monitoring programs are more sophisticated and there is less chance of carelessness or a casual attitude on the part of the operators. To date about 700 wells have been drilled in the British sector of the North Sea with no significant pollution incidents.

Page 20, table III-6 - It is not possible to classify all spills as either blowouts, explosions and fires, or pipeline breaks and leaks. Since most of the total spill volume is accounted for, the table should suffice for the purposes of this analysis. However, it should be clearly noted that these are not the only types of operations-related oil spill incidents.

Page 23, paragraph 1, line 2 - "this field" should be "these fields."

Page 24, paragraph 2, line 2 - Since many of the incidents which are considered "blowouts" in this ~~analysis~~ analys did not occur during drilling, it is not technically accurate to state that "one blowout occurs for every 245 wells drilled, spilling an average of about 1,294 barrels of oil." The Shell Fire, which accounts for 83.5 percent of the "blowouts" spillage, occurred during work-over operations. It is therefore not correct to predict the number of blowouts and the amount of spillage which will result based on the forecast of the number of wells which will be drilled. It should also be noted that not one pollution incident of greater than 50 barrels has resulted from a drilling blowout since 1969.

Pages 26-28 - The section on tanker accidents is so misleading and inaccurate that we suggest it be deleted, for the following reasons:

1. The analysis assumes that all the oil produced will be transported by tanker. This is after already assuming, in the pipeline accidents analysis, that all the production would be transported through pipelines.

2. Eighty-four percent of the spillage is attributed to tank washing without load-on-top systems. However, new Coast Guard regulations will require that all tankers have either segregated ballast sections or load-on-top systems.

3. The analysis is based on worldwide, not U. S., tanker incident data.

4. Total tanker spillage in the area may be reduced as a result of this sale, commensurate with a reduction in foreign tanker activity.

Page 68, paragraph 1, line 5 - It should be noted that the 0.38 million metric tons include tanker discharges.

Page 68, paragraph 2 - Comments on formation water, page 15, paragraph 1, apply here also.

Page 69, paragraph 1, line 4 - Formation waters are discharged from production platforms, not "operating rigs."

Page 72, paragraph 1 - It should be noted that no spills of greater than 50 barrels have occurred during exploratory drilling since 1969.

Page 73, paragraph 1 - Comments concerning the last sentence of page 15 apply to the sewage discharge requirements mentioned here.

Page 111, line 4, and page 112, line 3 - This section on geologic hazards mentions deep-seated faulting as being hazardous. Deep seated faults routinely are drilled through without problems. This is probably a confusion with shallow or surficial faults which are active or could become reactivated.

Page 111 - The evaluation of geologic hazards in volume 2 is not entirely consistent with that in volume 1. For example, in the discussion of natural gas pockets in shallow sediments, it is concluded in volume 2 that such pockets:

> "if encountered by a bottom founded rig or platform, could cause the structure to lose support. In the worst case, the structure might collapse, though it might only require repair or resiting" (vol. 2, p. 111, par. 2).

Quite a different impression of the risk is given in volume 1, where it is stated with respect to natural gas pockets in the shallow subsurface that "this hazard can be detected (Sieck, 1975) and allowed for by geophysical studies before drilling commences" (p. 88, par. 1). Similarly, the hazard from faults is evaluated differently in the two volumes. It is concluded in volume 1 that "High resolution geophysical studies ... should provide adequate information before drilling commences" (p. 85, par. 1). However, in volume 2 it is stated that "Sudden displacement of a fault could shear pipelines, casing, or damage bottom supports for rigs or platforms" (vol. 2, p. 112, par. 1). It would be advisable, at least, to include the former evaluation in the latter section.

Page 112, paragraph 1, last line - Reference to Sieck, 1975, is not listed in the bibliography.

Page 112, paragraph 2, line 5 - Liquefaction should be defined.

Page 113, paragraph 1 - Fluidization or liquefaction is not due to the fineness of the sediment itself, but usually to a mixture of sand and silt with high porosities or void spaces which when disturbed loses shear strength completely and flows.

Page 113, paragraph 3 - "Techapi" should be Tehachapi (California).

Page 113 - Tsunamis are not wind generated and therefore it is incorrect to refer to fetch, a length of sea surface over which a constant wind is maintained. Tsunamis are due to earthquakes and are rare on the Atlantic coast.

Page 113, last line - Turbidity currents are unlikely on the shelf because of the gentle slope and low sedimentation rate, although some could occur at the heads of shelf canyons.

Pages 114-115 - Potential offshore impacts discussed include leakage into aquifers resulting from improper casing procedures. However, the environmental statement should also consider the possibility of long-term leakage from the aquifers with consequent pressure declines and related effects. Impacts of possible improper sealing of abandoned test holes or wells should be addressed. Effects of spills and wave-borne beach accumulations of oil droplets on shallow water-table or unconfined aquifers that are recharged principally by direct precipitation on beach areas should also be considered.

Page 115 - The section on air quality should include some discussion of the positive impacts of increased natural gas production. Natural gas is the cleanest-burning fossil fuel, creating no particulate matter, virtually no sulfur compounds, and far less nitric oxides than any other common fuel. Of the major fuels, natural gas can make the most significant contribution toward alleviating air pollution.

Page 136, last paragraph - It should be noted that most of the exploratory wells, including discovery wells, will be expendable and will be permanently abandoned in accordance with OCS Order No. 3.

Page 148, last paragraph - It is believed that this section distorts the potential of oil spill impacts on sport fishing and fails to reflect the historically harmonious relationship between sport fishermen and offshore operators. Only a major spill could impact sport fishing in the manner discussed. The beneficial reef effect of OCS structures is discounted because of the distance of the leasing area from shore and sport fishing areas. We suggest the potential of oil spills impacting these areas could be modified.

Page 152, paragraph 1, line 7 - There are no provisions for EPA jurisdiction over discharges from floating drilling rigs. "Vessels or other floating craft" are clearly excluded from the Federal Water Pollution Control Act and the Ocean Dumping Act applies only to material transported from the United States for the purpose of dumping. However, drilling mud and cutting discharges are regulated by USGS through OCS Order No. 7.

Page 155 - It should be noted in this section that historical resources which may never have been discovered could be located as a result of OCS oil and gas operations. Offshore archaeological surveys which probably could have never been justified on their own will be conducted in conjunction with oil and gas operations.

Page 246 - Comments concerning page 155 apply here also.

Page 303, section 3 - Any tract which has an oil spill proximity value of 0.9 is considered to have a "relatively high aesthetic degradation potential." Therefore, a tract falls in this category whether it is one day (spill travel time) from a marsh community or an ocean dumping zone.

A spill would certainly have less impact on a shipping, dumping, or archaeological area than it would on an outdoor recreation area or a marsh community. Therefore, we suggest that a scale be devised prior to the next sale so that the various uses of the continental shelf can be appropriately weighted. For example, outdoor recreation could have a 0.9 weighting factor while dumping might have a 0.1 weighting factor. If the spill proximity factor were 0.9 for both the recreation and dumping area, then the risk potential would be 0.81 (.9 x .9) for the recreation area and 0.09 (.9 x .1) for the dumping area.

Page 316, paragraph 2 - Although all abandonment programs must be approved by USGS, inspectors are not required to witness each abandonment operation.

Page 320, paragraph 2 - As previously mentioned (p. 152, par. 1), it does not appear that EPA has jurisdiction over floating drilling rigs. In any case, neither EPA nor USGS regulations prohibit the discharge of oil-free drilling muds, and no request for variance will be necessary. It will be required that operators submit a detailed list of the drilling mud constituents (see Order No. 7) which will be evaluated by USGS field personnel.

Page 344, paragraph 2, line 3 - Although pursuant to Secretarial Order 2974 the Supervisor must consult with BLM and FWS prior to plan-of-development approvals, there is no requirement that he coordinate such approvals with NOAA or the National Marine Fisheries Service.

Page 367, footnote - "District Engineer" should be changed to "District Supervisor."

Page 374, footnote - See comment on page 14, paragraph 2.

Page 388, paragraph 1 - In the Gulf of Mexico an alternative site has always been chosen when a cultural anomaly existed near the drill site. Because of directional drilling, it would be a very rare circumstance that no alternative site would exist.

Page 404, paragraph 1 - See comment on volume 1, page 558.

Page 405, caption for figure VIII-2 - One "Call" should be deleted in title.

Page 462 - See comment on volume 1, page 558.

Page 593, paragraph 2 - The technology now exists to lay large diameter pipelines in depths of 1,000 feet or more in harsh environments. For example, the semisubmersible pipelay/derrick barge Semac I, presently under construction in Mobile, will be capable of laying large diameter pipe in up to 1,000 feet of water in sea conditions encountered in the northern North Sea. With additional equipment the unit will be capable of laying in deeper water.

Page 630, last paragraph, line 7 - Mg/1 are approximately equivalent to parts per million, not parts per billion.

Page 675 - Table 6 contains data from an old Phillips Petroleum Company formation-water analysis. The accuracy of this table and its applicability to other OCS areas is certainly questionable. The attached table V lists trace metal concentrations of formation waters from various regions and from sea water. (Table V and tables IV and VII mentioned below are taken from "Environmental Aspects of Produced Waters from Oil and Gas Extraction Operations in Offshore and Coastal Waters" prepared by the Sheen Technical Subcommittee of the Offshore Operators Committee, September 30, 1975). For chromium and nickel the data differ significantly from that presented on page 675. Table IV, enclosed, contains further data on typical concentrations of inorganic components. Table 7 on page 676 compares questionable California formation-water data from a single source with State of California effluent limits, which many believe to be unrealistically stringent. Because of the wide variation in formation-water qualities, the limitations of the data, and the variations in discharge requirements, the data on pages 675 and 676 may be quite misleading and do not adequately assess the issue. To discuss the impacts of formation-water discharges, recent data which consider trace-metal ranges of a cross section of formation waters should be utilized along with a detailed analysis of sea water. Toxicity data similar to that in table VII, enclosed, should be included. Dilution and the relative contribution of trace elements from man-made sources and natural river flow must also be considered.

Page 742 - Two sections of OCS Order No. 2 have been omitted:

Section 2 A.(2) - Auxiliary Equipment
Section 2 B. - Drive Pipe or Structural Casing

Volume 3

Errata Sheet for Visuals - Indicates "Salt Domes" should be coded in dark green on visual #3, but text on page 55, volume 1, refers to them as igneous intrusions or salt diapirs. "Salt Dome" should be replaced with "Igneous Intrusion or Salt Diapir" on visual #3.

Visual 3 - See comments for page 52, volume 1.

Acting Director

Enclosures 3
Table IV
Table V
Table VII

Table V

MEDIAN CONCENTRATIONS OF TRACE METALS IN PRODUCED WATERS[a)]

Median concentration (equaled or exceeded by 50% of the samples) in each area[1]

	Number of samples	Total solids (median) (g/l)	Co	Cr	Cu	K	Li	Mg
Illinois Basin	22	98	ND	2p	10p?	300	15	6,000
Louisiana and Texas Gulf Coast	79	69	ND	<1p	<25p	300	ND	250
East Texas	88	66	ND[2]	ND	< 1	<50	ND	250
North Texas	24	222	ND	<1p	150p	300	ND	5,000
West Texas and New Mexico	148	111	ND	2p	1p	350	15	1,000
Permian only	74	143	ND	2p	2p	400	10	1,000
Pennsylvanian only	34	115	ND	3p	< 1p	300	10	1,000
Silurian-Devonian only	15	55	ND	2p	4p	300	10	400
Ordovician-Cambrian only	21	67	ND	<2p	4p	400	15	800
Anadarko Basin[3]	118	137	ND	10p	10p	250	10	1,550
Williston Basin, post-Paleozoic	25	59	<5p	<2p	<25p	300	ND	250
Williston Basin, Paleozoic	55	173	ND	3p	3p?	800	35	600
Powder River Basin	22	5	<5p	<2p	<25p	300	ND	40
Other Wyoming	28	5	ND	ND	ND	300	ND	100
Colorado	18	5	<5p	ND	<25p	300	ND	30
California	116	18	ND	5p	5p	45	ND	90
Seawater	-	35	0.27p	0.04p-0.07p	1p-15p	380	0.1	1,272
Estimated Detection Limit	-	-	1p	1p	1p	50	2	10

	Mn	Ni	Sn	Sr	Ti	V	Zr
Illinois Basin	175p	ND	< 1p	300	<10p	ND	<10p
Louisiana and Texas Gulf Coast	3.5	<1p	< 1p	85	<10p	ND	<10p
East Texas	3.3	<1p	3p	350	ND[2]	ND[2]	ND
North Texas	45	15p	12p	450	7p?	ND	<10p
West Texas and New Mexico	1.8	<1p	< 1p	200	<10p	ND	ND
Permian only	1.7	<1p	< 1p	90	<10p	<1p	ND
Pennsylvanian only	2.8	<1p	< 1p	300	<10p	<1p	ND
Silurian-Devonian only	300p	<1p	1p	90	<10p	ND	ND
Ordovician-Cambrian only	400p	<1p	1p	250	<10p	ND	ND
Anadarko Basin[3]	5.6	6p	2p	300	<10p	<1p	<10p
Williston Basin, post-Paleozoic	300p	<3p	< 1p	100	ND	<1p	ND
Williston Basin, Paleozoic	660p	ND	< 1p	95	<10p	<1p	ND
Powder River Basin	450p	<3p	< 1p	25	<10p	<1p	<10p
Other Wyoming	300p	ND	< 1p	20	<10p	<1p	ND
Colorado	300p	<3p	<10p	20	<10p	<1p	<10p
California	950p	10p	2.5p	10	<10p	<1p	ND
Seawater	1p-10p	5.4p	3p	13	Present	0.3p	ND
Estimated Detection Limit	1p	1p	1p	16	10p	1p	10p

[a)] Taken from Rittenhouse, Fulton, Grabowski, and Bernard

[1] ND = below detection limits; p = concentration in parts per billion, otherwise parts per million.

[2] No data; less sensitive methods of analysis used.

[3] Includes Oklahoma Platform and Ardmore Basin.

Table IV

TYPICAL CONCENTRATION RANGES OF INORGANIC COMPONENTS IN PRODUCED WATERS

Typical Concentration	Component
parts per hundred	Na, Cl
often > 300 ppm	Ca, Mg, So
> 50 ppm	K, Sr
1 to 50 ppm	Al, B, Ba, Fe, Li
ppb (most produced waters)	Cr, Cu, Mn, Ni, Sn, Ti, Zr
ppb (some produced waters)	Be, Co, Ga, Ge, Pb, V, W, Zn

Taken from Rittenhouse, G.; Fulton, R. B. III; Grabowski, R. J.; and Bernard, J. L. (1969), "Minor Elements in Oil Field Waters," Chemical Geology 4, pages 189-209.

Table VII

TOXIC ELEMENTS OF CRITICAL IMPORTANCE IN MARINE POLLUTION BASED ON POTENTIAL SUPPLY AND TOXICITY, LISTED IN ORDER OF DECREASING TOXICITY[a)]

	Rate of Mobilization (10^9 g/yr)*			Toxicity+	Relative Critical Index (10^{12} liters/yr)	
Element	A(man) Combustion of Fossil Fuels	B(natural) River Flow	C Total	D mg/l	A/D	C/D
Mercury	1.6	2.5	4.1	1×10^{-4}	16,000	41,000
Cadmium	0.350**	-?-	3.0**	2×10^{-4}	1,750	15,000
Silver	0.07	11	11.1	1×10^{-3}	70	11,100
Nickel	3.7	160	164	2×10^{-3}	1,350	82,000
Selenium	0.45	7.2	7.7	5×10^{-3}	90	1,540
Lead	3.6	110	113.6	1×10^{-2}	360	11,360
Copper	2.1	250	252.1	1×10^{-2}	210	25,210
Chromium	1.5	200	201.5	1×10^{-2}	150	20,150
Arsenic	0.7	72	72.7	1×10^{-2}	70	7,270
Zinc	7	720	727	2×10^{-2}	330	36,350
Manganese	7.0	250	257	2×10^{-2}	350	12,850

[a)] From Ketchum, Reference 56.

*After Bertine and Goldberg (1971) (except for fossil fuel production of cadmium). Reference 57.

**Value from Third Annual Report, Council on Environmental Quality, 1972. The total includes addition to soil and thus may be an overestimate. Reference 58.

+ Water Quality Criteria: Concentration considered to pose minimal risk of deleterious effect. Reference 59.

56. Ketchum, B. H. (1973), "Symposium on Ocean Pollution," Statement made before Senate Commerce Committee, Subcommittee on Oceans and Atmosphere, June 12.

57. Bertine, K. K. and Goldberg, E. D. (1971), "Fossil Fuel Combustion and the Major Sedimentary Cycle," Science 173, pp. 233-235.

58. Council on Environmental Quality (1972), "The Third Annual Report of the Council on Environmental Quality," U. S. Government Printing Office, Washington, D. C. 20402, August.

59. National Academy of Sciences (1974), "Water Quality Criteria," U. S. Government Printing Office, Washington, D. C.

ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

In Reply Refer To:
FWS/OBS

FEB 9 1976

Memorandum

To: Director, Bureau of Land Management
Acting Deputy Associate
From: Director, Fish and Wildlife Service

Subject: Draft Environmental Statement - OCS Sale No. 40 - Offshore the Mid-Atlantic States

The FWS has reviewed the subject statement and finds that in general it adequately reviews the proposal and considers the various alternatives. We do note deficiencies, however, particularly in the discussion on living resources. Our reviewers have made a number of comments on specific sections of the statement which we hope will prove helpful in the preparation of the final statement.

Comments

SECTION I. DESCRIPTION OF THE PROPOSAL.

Subsection I. F. 2.b., pp. 28-37, v.1.

Figure I-4 on p. 30 depicts the Coastal Zone Area, Mid-Atlantic Region. The base map used for this figure and subsequently throughout the report depicts the coastline extending from the tip of Long Island south to the tip of the Delmarva Peninsula and including a small portion of the eastern shore of the Chesapeake Bay. Apparently, this delineates the nearshore and onshore environments that might be impacted by the proposed action. However, the discussion in this section is unclear with regard to how these limits were selected. Are the areas shown in this figure the CZM boundaries as defined by the various states, or were the areas to be considered selected by BLM?

There is throughout the statement a lack of consistency in discussions of impact area. Generally, Chesapeake Bay is excluded from consideration (see footnotes on pages 152 and 163). However, much of the cited reference material

RECEIVED

FEB 12 1976

DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

is from outside the area delineated and portions of the statement dealing with socio-economic characteristics (see Figure II-90, p. 507) include a large area that entirely surrounds Chesapeake Bay.

Environmentally, Chesapeake Bay is a vital component of the Mid-Atlantic area and should not have been excluded. There are possible onshore sitings for oil and gas support activities at locations such as Hampton Roads-Norfolk, Virginia and Crisfield and Baltimore, Maryland. Activities at these locations could have an impact related to the degree of activity on the Chesapeake estuary. Much of the commercial and sport fisheries of the Mid-Atlantic are directly dependent on the Bay system. Important species such as striped bass, bluefish, weakfish, and blue crabs annually move between Bay and Ocean.

A similar, but perhaps weaker case could be made for including Long Island Sound and Narragansett Bay in the impact area as those areas would be impacted if they became a site for major onshore facilities.

It should also be noted that Pennsylvania's program on the tidal Delaware River was excluded in the discussion of the state Coastal Zone Management programs. This area is important because of the many petroleum related facilities already clustered near Philadelphia and because impacts in this area can affect the entire Delaware Bay.

SECTION II. DESCRIPTION OF THE ENVIRONMENT

Subsection II. F., Biological Communities, pp. 213-327.

This section is poorly organized and weak in several respects. The descriptive information should be of the kind and in a format that would readily allow evaluation of possible impact. It appears as though the major divisions describing types of biological communities should have been 1) offshore (the actual exploration area) and 2) nearshore, estuarine and onshore (the potential impact area). These were the divisions used in the Programmatic Environmental Statement and it is difficult to understand the change for this site specific statement.

This entire subsection relies too heavily on listings of species taken from various publications. There is little attempt to synthesize available data. An ecosystem approach would provide much better descriptions of the biological communities.

Many of the cited studies are not even relevant to the Mid-Atlantic region. There is too much reliance on the TRIGOM report that was written for the North Atlantic. That study is continually cited although it covers only an area south to Sandy Hook, N.J. and emphasizes research performed in the Gulf of Maine.

A study that would have proved a valuable reference for this section is Coastal and Offshore Environmental Inventory - Cape Hatteras to Nantucket Shoals, Marine Experiment Station, Graduate School of Oceanography, University of Rhode Island Marine Publication Series, 1973. It is interesting to note that individual Chapters of the above referenced study are cited in the statement's Bibliography, but reliance for writing the text was placed on the TRIGOM report.

Subsection II. F. 1.b., pp. 224-242, v.1. - Zooplankton

This subsection on zooplankton barely notes that eggs and larvae of fish and crustaceans are included in this classification.

Subsection II. F. 1.c., pp. 243-251, v.1. - Benthic Flora

This subsection on benthic flora includes lengthy discussion of marine algae, but never mentions eelgrass (Zostera marina) the most important marine plant.

Subsection II. F. 1.c., pp. 251-273, v.1. - Benthic Fauna

In this subsection on benthic fauna, the important commerical shellfish are just other Latin names in a list. There should be at least a brief note saying that they are included and will be discussed at greater length in the commercial and sport fisheries subsection.

Subsection II. F. 1.d., pp. 273-294, v.1. - Fish

Too much of the data in this subsection on fish is from TRIGOM and does not really pertain to the Mid-Atlantic region.

Subsection II. F. 1.e., pp. 294-298, v.1. - Marine Mammals

This subsection on marine mammals is little more than a listing of sightings and strandings. Most of the species normally occur in deeper waters and north of the study area and are therefore never more than casual visitors. A discussion of all of the whales and smaller cetaceans occuring in this area, regardless of their inclusion on the endangered species list, should be in this subsection. There should be enough discussion of food and the tendency of most species to travel in "pods" since these could be factors in possible impact of oil spills. Particular recognition should be given to the Right Whale since it is extremely rare where it was common and most of the surviving members of the species may migrate through or near the lease area.

Suggested additions to Subsection II. F. - Biological Communities

There should be a section on marine turtles. Six species have been recorded in the Mid-Atlantic area, including endangered species, and females occasionally come ashore on isolated beaches to lay eggs.

There should also be a section added on pelagic birds. These are species that spend all but nesting seasons far from shore. In summer, there are shearwaters and petrels in the Mid-Atlantic region that nest on remote islands in the southern hemisphere. In winter, Arctic nesting birds are present, primarily alcids, gannets, fulmars, kittiwakes, skuas, and phalaropes. These species sometimes concentrate in vast numbers and a major portion of a species could be on or near the lease area at a given time.

Subsection II. F. 2., pp. 299-327, v.1. - Onshore

As previously noted, a combined discussion of nearshore and onshore biological communities would be preferred. A discussion of that type would require repeated categories for plankton, benthos, and fish, but there would be little duplication because species differ.

Subsection II. F. 2.a., pp. 299-313, v.1. - Coastal Vegetation

The discussion based on states creates confusion and duplication. There are only slight and gradual differences from north to south. An adequate discussion could be based on three broad communities: 1) marshes; 2) dunes and beaches; and 3) forests.

Subsection II. F. 2.b., pp. 314-319, v.1. - Marine and Coastal Birds

This entire section should be redone. The two references used are inadequate. A better organization may be similar to that suggested for coastal vegetation. Suggested categories would be: 1) waterfowl and marsh birds; 2) shore and wading birds (sandpipers, gulls, terns, and herons); and 3) upland birds (emphasizing the importance of coasts during migration). A fourth category could highlight rare and endangered species.

The section on endangered and declining species beginning on page 318 is poor. Pelicans are out of range and can be excluded here. Subspecies distinctions for bald eagles and peregrines are not necessary as any found here are endangered. The strange group of species at the bottom of the page includes several that are entirely accidental in the Mid-Atlantic region and others that are reasonably common.

The previously cited reference, Coastal and Offshore Environmental Inventory - Cape Hatteras to Nantucket Shoals might prove to be useful for this section.

Subsection II. F. 2.c., pp. 319-327, v.l. - Wildlife

The mere listing of species that occur in the region has little value. At least some description of the dependence of the various species on their habitats should be given. A general classification for wildlife could be used such as: 1) mammals; and 2) reptiles and amphibians.

On page 325, the separate section on endangered species is not necessary. The shortnosed sturgeon could be discussed in the fish section and the Delmarva Peninsula Fox Squirrel could be discussed in the wildlife - mammals section.

Table II-64 showing species appearing on state endangered species lists adds to the confusion in this section since different states have different criteria for listing. Also, many of the species cited occur only in hilly, western portions of the states.

Subsection II. G. l.e., p. 385, v.l. - Recreation and Tourism

Refuges should not be lumped with seashores as "major Federal coastal recreation areas", particularly since areas such as Wertheim NWR, Wallops Island NWR, and Fisherman's Island NWR are now closed to public use.

Subsection II. G. l.f., pp. 421-468, v.l. - Commercial and Sport Fisheries

This section is generally complete and well organized, except for the omission of Chesapeake Bay.

On page 455, the statement is made that blueback herring spawn "in late summer", the correct statement is that blueback herring spawns later in the season than the alewife (not necessarily in late summer).

SECTION III. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

Subsection III. A. 4., pp. 52-66, v.2. - Oil Spill Trajectories

This section relies heavily on the findings of the M.I.T. oil spill trajectory model. The creators of the M.I.T. model have commented on the lack of reliability of the wind and current data that was available to them, however, the times to shore generated in the model are presented in this statement in a manner that gives the impression that they are to be accepted as realistic. Based upon the arrival times given in the Coast Guard study cited on pages 64 and 65, it appears that actual arrival times would be open to conjecture. It appears that the first criticism of the Coast Guard model (constant wind speed and direction) may be valid, however, the logic behind the second criticism is somewhat nebulous. It is stated that the model uses monthly averages of offshore wind data and monthly averages of water current data. If monthly averages of offshore wind data are used in the model, then the second criticism concerning the use of non-average wind data does not seem warranted.

Since there is quite a difference in arrival times for the M.I.T. and Coast Guard models, some further attempt should be made to reconcile the findings of the models in the final statement.

Subsection III. B. 2., pp. 74-110, v.2. - Biological Communities

On page 80, the report states that "little information exists as to the effects of crude oil on zooplankton". However, a summary of information on analytical and assay work is in Moore, Dryer, and Katy, A Preliminary Assessment of the Environmental Vulnerability of Machias Bay, Maine to Oil Supertankers, MIT SG 73-6, 1973.

On page 89, the statement is made that "Blumer, Souza, and Sass (1970) reported ....fuel oil had been absorbed or ingested and could be found in oyster bodies and scallop muscles in sufficient quantities". This sentence needs to be clarified - sufficient quantities for what?

Subsection III. B. 2.d., pp. 109-110, v.2. - Impact on the Marine Mammals

This section could be broadened to include sea turtles. There should also be a note that whales are sensitive to underwater noises and could be adversely affected by the noise associated with exploration and development.

Suggested additions to Subsection III. B. 2. - Biological Communities

There should be a section on the impact on pelagic birds as well as the section beginning on page 260 in the "onshore" portion of the report. Although the effects of nearshore spills get more attention, spills in offshore waters can have just as much impact on offshore species such as alcids. This section should also note the possible impacts of chronic, low-level pollution through accumulation of toxic hydrocarbons in food webs, as most pelagic birds feed on planktonic organisms at the surface.

Subsection III. C. 2., pp. 134-150, v.2. - Commercial and Sport Fisheries

Commercial fishing can also be adversely effected in more subtle ways such as competition for "watermen", vessels, and port facilities.

There should also be greater emphasis on the potential impacts of oil-related activities in estuarine and nearshore habitats that provide spawning and nursery grounds for the fish taken in offshore waters. Chesapeake Bay cannot be ignored.

Subsection III. D. 2., pp. 253-284, v.2. - Impacts on the Natural Environment

The discussion of effects of oil spills on salt marshes focuses only on possible damage to the dominant plant species. It should also deal with the more fragile aspects of the marsh community. The perennial plants are the "toughest" components.

On page 256, *Salicornia* and *Spartina* are not algal species.

The onshore activities associated with oil development could have a much greater impact on wetlands than oil spills, but they receive only perfunctory comment in the last paragraph. Recovery time is a mute point since development on wetlands is almost irreversible.

The discussion beginning on page 263 needs revision. The opening sentence is equally true of other coasts. Refuges include direct ocean frontage and birds other than marsh species can be impacted by spills.

Subsection III. E. 4.a., pp. 288-289, v.2. - Oil Spills

The average speed of 1.6 miles per day indicated for a spill to travel seems low compared to an inferred surface drift over the continental shelf of the Mid-Atlantic Bight on the order of 10 miles per day as reported in the *Coastal and Offshore Environmental Inventory - Cape Hatteras to Nantucket Shoals*.

SECTION V., PP. 369-388, V.2. - ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

Many of the impacts noted in this section can be minimized and the discussion should emphasize that point. This section seems to over-emphasize impacts of oil spills and plays down the potentially more harmful impacts of nearshore and onshore developments.

SECTION VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

There is an inconsistency on page 394, a species is not likely to be endangered if it has large populations.

We appreciate the opportunity to comment at this time.

Alfred C. Fox

OFFICE OF THE DIRECTOR

United States Department of the Interior

BUREAU OF MINES
2401 E STREET, NW.
WASHINGTON, D.C. 20241

February 10, 1976

RECEIVED

FEB 19 1976

Rolland A. Reid

FEB 18 1976

Memorandum

To: Director, Bureau of Land Management

Through: Deputy Assistant Secretary--Energy and Minerals

From: Director, Bureau of Mines

Subject: Draft environmental statement, Bureau of Land Management, proposed 1976 Outer Continental Shelf oil and gas lease sale, offshore the Mid-Atlantic States, OCS Sale No. 40

The Bureau of Mines Eastern Field Operation Center, Pittsburgh, has reviewed the draft environmental statement prepared by the Bureau of Land Management for the proposed 1976 Outer Continental Shelf oil and gas lease sale offshore the Mid-Atlantic States in an area known as the Baltimore Canyon Trough. The potential for discovery of new oil and gas reservoirs, their development and production, and the potential impacts on other marine minerals are discussed in the statement.

Exploration, development, and production in the OCS tracts would result in a demand for minerals to support nearby shore-based activities. Secondary impacts of such activities would result from production of construction mineral commodities, possibly by ocean mining of sand. These impacts are also discussed.

In volume 2 we note some numbers different from Bureau of Mines published data. On page 446, Bureau figures are 212,035,000 and 172,931,000 barrels, respectively, for January and February 1975. On page 448, Canadian natural gas imports were 1,028 Bcf, which were 4.6 percent of U.S. consumption and 33 percent of Canada's production.

The environmental statement for OCS Sale No. 40 provides sufficient information and adequate discussion of its effect on minerals and the minerals industry. We have no suggested changes.

Thank you for the chance to review this draft.

TV Falkie

Thomas V. Falkie
Director

United States Department of the Interior
NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:
L7619-MQ

20 JAN 1976

Memorandum

To: Director, Bureau of Land Management -730

Through: Assistant Secretary for Fish and Wildlife and Parks, [illegible] RA 1-21

From: Acting Associate Director, Park System Management

Subject: Draft Environmental Statement for Proposed 1976 Outer Continental Shelf Oil and Gas General Lease Sale in the Mid-Atlantic Offshore New Jersey and Delaware (DES 75-60)

As requested in your memorandum of December 10, 1975, we have reviewed the subject statement and have no comments.

Raymond L. Freeman

RECEIVED
JAN 22 1976
D. [illegible] S
ENVIRONM[illegible] SSESSMENT

United States Department of the Interior

BUREAU OF OUTDOOR RECREATION
WASHINGTON, D.C. 20240

IN REPLY REFER TO:

DES-75/60

JAN 27 1976

Memorandum

To: Director, Bureau of Land Management

From: Assistant Director, Bureau of Outdoor Recreation

Subject: Draft Environmental Statement for Proposed 1976 Outer Continental Shelf Oil and Gas General Lease Sale in the Mid-Atlantic Offshore New Jersey and Delaware

We have reviewed the subject draft environmental statement and find that it is adequate from an outdoor recreation viewpoint.

Fred J. Jones

RECEIVED
JAN 30 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

6. State Agencies

STATE OF NEW YORK
DEPARTMENT OF LAW
TWO WORLD TRADE CENTER
NEW YORK, N.Y. 10047
TELEPHONE: 488-7567

LOUIS J. LEFKOWITZ
ATTORNEY GENERAL

PHILIP WEINBERG
ASSISTANT ATTORNEY GENERAL
IN CHARGE OF
ENVIRONMENTAL PROTECTION
BUREAU

BY HAND

February 17, 1976

Manager
New York Outer Continental Shelf Office
Bureau of Land Management
Department of the Interior
6 World Trade Center
Suite 600 D
New York, New York 10048

Re: Proposed Mid-Atlantic Outer
Continental Shelf Oil and
Gas Lease Sale No. 40

Dear Sir:

I enclose the original and 1 copy of the comments of the Attorney General of the State of New York regarding the above-mentioned proposed lease sale.

Very truly yours,

LOUIS J. LEFKOWITZ
Attorney General
By

JOSEPH J. ZEDROSSER
Assistant Attorney General

JJZ:rab
Enc.

COMMENTS OF THE ATTORNEY GENERAL OF THE STATE OF NEW YORK ON U.S. DEPARTMENT OF THE INTERIOR PROPOSED MID-ATLANTIC OUTER CONTINENTAL SHELF OIL AND GAS LEASE SALE NO. 40

February 17, 1976

LOUIS J. LEFKOWITZ
Attorney General of the
 State of New York
Office & P.O. Address
Two World Trade Center
New York, New York 10047
Tel. No. (212) 488-7567

PHILIP WEINBERG
JOSEPH J. ZEDROSSER
Assistant Attorneys General

DEBORAH FEINBERG
Environmental Scientist

The Attorney General of the State of New York strongly opposes proposed Mid-Atlantic oil and gas lease sale No. 40 and, indeed, the Interior's Department's over-all national program to increase oil and gas leasing on the Outer Continental Shelf ("OCS"). The Attorney General maintains that the proposed sale and the national program violate the substantive standards of the National Environmental Policy Act ("NEPA"), the Outer Continental Shelf Lands Act and other applicable law. In addition, the Department's Draft Environmental Statement ("DES") on the proposed sale is inadequate in light of the requirements of NEPA. As indicated in our letter to the Director of the Department's Bureau of Land Management on December 22, 1975, we contend that insufficient time has been allowed for the submission of these comments. These comments are not all-inclusive and should not be regarded as limiting our objections to the proposed sale and the national program. We also incorporate by reference our comments of February 24, 1975, and September 8, 1975, regarding the national program.

THE QUESTION OF NEED AND ALTERNATIVE ENERGY SOURCES

This proposed sale and the national program have never been demonstrated to be a necessary part of a comprehensive national energy policy. Moreover, the discussion of alternatives in the DES fails to adequately analyze over-all energy supply and demand. There is only a brief and misleading reference to the Federal Energy Administration's Project Independence Report (DES Vol. 2, pp. 454, 456-7) and no evidence of analysis of that report and others, such as those by the Ford Foundation, which have quantified energy supply and demand on the basis of various scenarios. The DES does not point out the role which present energy prices play in reducing demand. The Project Independence Report noted that sustained world oil prices at the $11 level alone will result in slowing the energy demand growth rate to 2.7% per year.

The descriptions of individual energy alternatives are cursory. Blanket references, without comment, to a study prepared at the University of Oklahoma do not substitute for reasoned analysis and consideration by the Department of the Interior.

One example is the unsophisticated treatment of energy conservation. Indeed, the Interior Department's treatment of this issue in its various documents raises most serious questions about both the merits of the national program and this proposed sale and the Department's compliance with NEPA. In the purported "Final Environmental Statement" on the national program ("FES"), the Department conceded that energy conservation of the type considered in the Project Independence Report would more than substitute for OCS production through 1985 (Vol. 2, p. 296). In the FES, the Department also noted that a conservation scheme in accord with the Technical Fix cost analysis of the Ford Foundation would bring net benefits, not costs, to society as a whole (FES, Vol. 2, p. 300).

Less than three months later, a Program Decision Option Document ("PDOD") was presented to the Secretary of the Interior. In the PDOD, the Department apparently reversed itself and stated that mandatory conservation measures impose net costs on consumers (PDOD, pp. 11, 28). Moreover, it is concluded and advocated in the PDOD that as long as the total monetary and environmental production cost of OCS oil is less than the current price of oil, mandatory conservation should not even be considered (Ibid.)* The cryptic explanation for this does not withstand scrutiny. It is stated (PDOD, p. 11) that a barrel of produced oil has a value in excess of its total production costs. This ignores the fact that unextracted petroleum is a national resource which has value as such and that production of oil involves, in the language of NEPA, an irreversible and irretrievable committment of a resource. The PDOD does not demonstrate that produced oil has value in excess of the sum of the value of the unextracted petroleum and

---

* It is significant that, although the PDOD refers to the existence of environmental costs of producing OCS oil, it never attempts to quantify them and simply assumes that OCS oil production has costs which are less than the current price of the oil (Ibid.).

the cost of production. Without even taking into consideration the value of petroleum saved for the future, production and use of 1 barrel of oil as opposed to conservation of that barrel involves a cost not considered in the PDOD: loss of the present value of the unextracted petroleum.

The PDOD was not available for comment prior to the Secretary's decision to adopt the national program and recently the Department had to be ordered by a Federal District Court Judge to make some affirmative efforts to distribute it.

In the DES, the Interior Department persists in its inadequate and slanted consideration of energy conservation. The Department claims that energy savings cannot be equated with proven decline of available oil and gas (DES, Vol. 2, p. 419) and makes no mention of the fact pointed out in the FES that energy conservation could more than substitute for all OCS production through 1985 (FES, Vol. 2, p. 296). The Department, without explanation, stresses the "negative impacts", especially in the Mid-Atlantic region, of energy conservation, including reduction in standard of living, industrial plant closings and higher consumer product prices (DES Vol. 2, p. 421). The FES had discounted these impacts under the Ford Foundation Technical Fix strategy (FES, Vol. 2, p. 300). The DES is even internally inconsistent in that at DES, Vol. 2, p. 421, it speaks of increased unemployment resulting from energy conservation, while on the preceding page it states that energy conservation would probably increase over-all employment and particularly employment in low wage jobs. This is important because unemployment is most strongly felt at the low wage level.

Another example of the inadequate consideration of alternatives in the DES and the PDOD is the treatment of oil and gas imports. Both speak ominously of the vulnerability of United States reliance on imports* (DES, Vol. 2, pp. 447, 449; PDOD, p. 2). The PDOD flatly says that a decision not to adopt the national program will likely mean increased foreign imports (pp. 14-15). Unconsidered is the fact that the Project Independence Report concluded that, at an $11 per barrel world oil price, imports will decrease so that there will hardly be an import problem in 1986 even under the "base case" assumption, e.g., without Atlantic OCS development (p. 31) and that, in any event, emergency demand conservation and supply allocation are effective and efficient means of reducing the economic cost of any interruption in oil imports that could occur (p. 404).

The DES (Vol. 2, p. 446) also states that increasing imports brings "problems of . . . refinery capacity" but does not specify the problem. The DES (pp. 165, 169) claims that

---

*Interior's observation that international decisions are beyond the control of Mid-Atlantic states (DES, Vol. 2, p. 447) is ironic in light of the Department's own insensitivity and intransigence in dealing with coastal state concerns.

OCS oil would substitute on a 1 for 1 basis for oil which would otherwise be imported and that no new refineries would be needed for OCS production.

The analysis of the oil spill hazard associated with oil tanker imports is also superficial. The PDOD (p. 5) speaks of relative oil "spill" rates for tankers and for OCS production (without tankers) but makes no mention of the extent to which tanker "spills" occur relatively far from coastal areas. This is particularly significant, since when one looks at the FES, Vol. 2, pp. 39-40, one discovers that the Department includes operational discharges among tanker "spills." Neither the PDOD nor the DES discuss the extent to which the technology to prevent oil pollution by tankers may be better developed than the technology to prevent oil and heavy metal pollution resulting from OCS activities not utilizing tankers. The DES at Vol. 2, p. 400, contrasts the danger of future tanker oil spills resulting from continued reliance on imported oil with the "expected" use of pipelines in Mid-Atlantic OCS development and characterizes the tank transport as less desirable than pipelines. Yet, as recently as in Final Environmental Statement for Southern California Oil and Gas Lease Sale No. 35, Vol. 2, p. 51, the Department claimed that it was unable to determine the relative risk of pipeline versus vessel transportation of crude oil.

THE SCOPE OF THE ACTION

A critical aspect of the proposed Mid-Atlantic lease sale and the national program is that the Department apparently knows so little about what it proposes to lease. Even the figures supplied in the DES indicate that the proposed lease area may contain from .4 to 1.9 billion barrels of oil and from 2.6 to 9.4 trillion cubic feet of gas. This lack of knowledge affects the proposed action in a number of ways.

First, how can the Secretary of Interior live up to his legal obligation to obtain fair market value for this valuable natural resource when he is ignorant of the extent of the resource? Plain common sense, as well as applicable law, indicates that, if a lease sale were otherwise desirable, the Department should first conduct exploration. The assertion in the DES (Vol. 2, pp. 465-66) that to do so would be less cost-effective than the present system is not adequately supported or discussed. Moreover, the discussion in the PDOD (pp. 34-35) regarding government exploration is both inadequate and misleading.*

---

* The discussion on stratigraphic drilling in the PDOD (pp. 41-43) is also obtuse and fails to recognize that any such drilling requires an environmental impact statement.

Second, ignorance of the extent of the petroleum resource obviously affects the Secretary's ability to make the necessary cost-benefit analysis before taking action. A good faith weighing of the environmental costs of leasing against the supposed benefits requires that the benefits be ascertained. Presumably, even the Department might conclude the small benefits would not warrant the environmental costs.

A third way in which the Department's lack of knowledge affects the proposed action is that the description of the action does not provide as meaningful a basis for analyzing environmental cost as is required. For example, we are told in the DES that from 200 to 880 producing wells, from 10 to 50 platforms and from 50 to 570 miles of off-shore pipeline corridors are expected to result from the Mid-Atlantic lease sale. These ranges vary by a factor of 5.

THE ENVIRONMENTAL AND RELATED SOCIOECONOMIC IMPACTS

We have indicated in previous comments that the FES inadequately considered the environmental and related socioeconomic effects of the national program. To make matters worse, the PDOD inaccurately set forth such information as was provided in the FES and minimized even those adverse effects recognized in the FES. These documents failed to adequately quantify the adverse impacts of the national program either in monetary terms or non-monetary terms, e.g., number of marine organisms that might be killed by oil pollution (PDOD, pp. 16-18, 27-28).

The DES continues this grossly inadequate treatment of adverse effects. This inadequacy is all the more egregious because, when we and others criticized the adequacy of the FES, we were told that specifics would be provided in the environmental statements to each lease sale (e.g., Interior's Response to New York Attorney General's Comments, FES, Vol. 2, p. 961; Interior's Response to Comments of Southern California Counsel of Local Governments, FES, Vol. 2, pp. 654-5). To describe each inadequacy would require us in effect to perform the Department's function by writing an environmental statement. The following pages will point out merely some example of the pervasive inadequacy of the Department's consideration of adverse effects and the arbitrariness of its policies.

Pollution By Oil And Gas

The analyses of the causes and extent of likely oil spills are deficient. Regarding pipeline accidents, for example, the DES cites Gulf of Mexico figures for a period from 1970 when new regulations went into effect and then predicts lower spill rates because of unspecified improved technology and stricter regulations. The DES, however, fails to describe the differences between conditions in the Gulf and those in the Mid-Atlantic. The impact analysis at pages 22-23 of the DES makes no reference to difficulties that may be encountered in checking to make sure that pipelines supposedly buried in areas of hard-packed sediment are in fact buried. This section also does not refer to the effect of migrating sand waves in uncovering supposedly buried pipelines. Also unquantified is the extent to which fishing equipment, such as the 5-ton doors used on trawls, can rupture a pipeline. The problems of detecting pipeline leaks are not discussed.

The discussion of oil and gas well blow-outs during drilling (DES, Vol. 2, pp. 24-25) is an example of the Department's persistent intent to proceed with leasing despite ignorance of the information necessary to predict the extent of such accidents.

The treatment of tanker accidents and operations illustrates the tendency of the DES to describe controversial issues so that reader's understanding will differ depending upon which part of the DES he is reading at the moment. The *a priori* assumption of the DES seems to be that tanker transport is less desirable than pipeline transport and at Vol. 2, p. 16, it is flatly anticipated that all oil and gas sales will be transported by pipeline. However, at Vol. 2, p. 26 of the DES, one learns that this will only be the case if pipelines are technically and economically possible. There is no detailed discussion of such feasibility.

The DES (Vol. 2, p. 12) then assumes that, to the extent tankers are used, tanker spills would only increase by some unspecified increment. It fails to quantify the extent to which there might be tanker shipments of OCS oil out of Mid-Atlantic ports as suggested in the PDOD, p. 18. The Department at DES, Vol. 2, p. 27, states that the spill projections that it provides are invalid but has not developed any better projections. That page of the DES also suggests that barging and lightering are significant probable OCS operations in the Mid-Atlantic although DES, Vol. 1, p. 15, states that barging will be prohibited for "continuous production" and tanker off-loading to barges in estuaries and bays is not anticipated. As significant operations, barging and lightering should be discussed in detail.

The consideration of oil spills resulting from natural phenomena is extremely superficial and founded on gross assumptions regarding both the phenomena themselves and the available technology. For example, how can the Department hope to proceed without analyzing the results of long-term seismic monitoring, particularly since there are known faults in the lease area? The Department's insensitivity is astonishing in light of the fact even it admits that pipelines are seriously vulnerable to soil instability (DES, Vol. 2, p. 35). The DES also does not specify the maximum winds and waves to which OCS equipment would be subjected and the impacts such forces will have on the equipment.

The DES reflects that the Department has not properly considered the fact that its lease area includes areas where undetonated explosives were jettisoned (DES, Visual No. 1), which could result in the loss of human life as well as spills and other damage. The statement (DES, Vol. 2, p. 151) that magnetometers could "easily pinpoint" unexploded ordinance is unsubstantiated, particularly since the ordinance may be buried many feet below the surface of the bottom. The DES does not even state what requirements will be placed on lessees in this regard. Similarly cavalier is the consideration of the effect of military activities conducted in the lease area (DES, Vol. 1, p. 468-70). Although it is conceded that gunnery exercises could result in death, oil spills and other damage (DES, Vol. 2, p. 150), the only effort to solve the problem apparently is to "reschedule" operations (Vol. 2, p. 347). Presumably intended to allow for the evacuation of personnel, mere rescheduling may not protect OCS structures.

The Department has been arbitrary in dealing with the danger of oil spills resulting from collisions of vessels with platforms. The DES (Vol. 2, p. 23) admits that 5 tracts in the leasing area extend into the outbound shipping lane

(Visual No. 1) and adds only that the placement of rigs and platforms in shipping lanes "probably" will not be allowed. The DES (Vol. 2, p. 386) estimates that some 62,600 acres, or 7% of the lease area, lie within shipping lanes or within what it regards as close proximity, i.e., 6 miles, and that another 233, 420 acres, or 27% of the lease area, are in or near a heavy traffic area outside of the shipping lanes. The DES and the PDOD (p. 17) fail to properly analyze the dangers inherent in this situation and the Department wrongfully persists in seeking to lease these areas.

This danger is compounded by the increased ship traffic resulting from OCS operations. While this increase is conceded at FES, Volume 2, page 35, the DES serves only to cloud this issue. The fact that leasing will take place in areas used by fishing boats further aggravates the problem.

As to oil pollution from operating procedures, the DES (Vol. 2, pp. 68-69) calculates the amount of oil introduced into formation water on the assumption that 1983 EPA standards are in effect even though exploration could begin in 1977 and production in 1979. The DES does not analyze the extent to which these formation waters consist of the more toxic light weight aromatics. The PDOD and DES also fail to discuss the possible deliberate or accidental underwater venting of natural gas, which would introduce aromatics.

The problem of the incidence and extent of chronic low-level leakage from OCS operations is not adequately discussed in the DES, particularly since even the DES (Vol. 2, p. 394) admits that this could lead to an irreversible commitment of fish and wildlife resources and habitats.

When the Department deals with the movement of oil which has been spilled, it confesses to its ignorance (DES, Vol. 2, p. 52) but is undaunted by it. It has not investigated the possibility that in heavy winds oil may be moved at more than 3% of its wind speed and that waves may continue after wind has ceased. It makes the bold assertion (DES, Vol. 2, p. 64) that various models developed for off-shore Long Island are not applicable here and chooses to ignore the fact that spills may occur along a transport route as well as at a drill site. See Devanney and Stewart, The Likelihood of Spills Reaching Long Island From Hypothetical Offshore Finds Over The Development's Life, M.I.T., Report to Nassau-Suffolk Regional Planning Council (1975). Not mentioned is another study of the area, Hardy, Baylor, Moskowitz and Robbins, The Prediction of Oil Spill Movement in the Ocean South of Nassau-Suffolk Counties, New York, S.U.N.Y., Stonybrook, New York, Technical Report Series 21.

Predictably, the Department, after mentioning these models, chooses as the "best available" the one which predicts the least likelihood of environmental harm (DES, Vol. 2, pp. 52-66). Later in the DES (Vol. 2, pp. 285 & ff.), the Department's "proximity evaluation" abandons all but the pretense of careful trajectory analyses. The proximity evaluation as a whole is grossly inadequate.

In neither the PDOD nor the DES does the Department sufficiently emphasize and detail the fact that the available technology is completely insufficient to contain and clean up off-shore oil spills. Indeed the available technology is sufficient to contain and clean up only some oil spills in protected waters. Characteristically, the DES' discussion of conditions present 80% of the time during the spring (Vol. 2, pp. 231-232) merely assumes that booms effective in 5-foot seas will be available and that adequate contingency plans will have been timely made and implemented. It is significant that, under the Natural Contingency Plan, the decision regarding who will be responsible for cleaning up a particular spill is made after the spill (DES, Vol. 2, p. 377), hardly a method designed to provide for a given response. The DES also fails to analyze the human effect of winter conditions in the Mid-Atlantic region upon the ability of men to contain and clean up an oil spill.

In discussing a lessee's oil spill contingency plan, the DES (Vol. 2, pp. 34-35) states that in order to implement its plan the lessee must have access to the most effective equipment and materials necessary to effectuate containment and clean up, given the "current" state of technology. Unfortunately, when one looks at proposed OCS Operating Order 7 for the Mid-Atlantic, which deals with such plans, one finds no reference to such a requirement. Prior regulatory practice provides no encouragement either, since OCS regulations and orders have not required the use of equipment which Coast Guard research has shown to be more efficient. Moreover, what does the DES reference to "current" state of technology mean? Surely, the equipment and materials should constantly be required to be upgraded as soon as improvements are developed. The DES is silent on elements of a cleanup system other than equipments and materials.

The PDOD and the DES seek to unjustifiably minimize the environmental effect of oil spills on organisms. The discussion of this topic is replete with error. The DES cites both bacteria (Vol. 2, p. 47) and dilution (Vol. 2, p. 139) as factors demonstrating the toxic effect of spilled oil. However, the DES does not consider that, while bacteria may have a beneficial effect on some compounds in oil, the first products of the bacterial decomposition of aromatic compounds may be more toxic than the parent compounds. It also does not analyze the extent to which dilution could inhibit microbial action and prolong toxic potential.

The DES (Vol. 2, p. 143) claims that the adults of most pelagic fish would "flee" an oil spill and minimize mortality. On wonders how fish could try to avoid sublethal levels of oil. These levels could have important effects on reproduction or other physiological processes which the Department does not adequately consider.

The DES fails to consider that documented toxicity levels for shrimp are an order of magnitude lower than those for the organisms discussed in the DES. Indeed, the toxicity information is generally unsatisfactory. The DES also makes no analyses of the available information regarding when, where and in what density the eggs and larvae of commercially important species are located in the Mid-Atlantic area in order to understand the effects of OCS activity.

In dealing with phytoplankton, the DES (Vol. 2, p. 80) refers to observations that, after 24 hours, copepods suffered no visual harm from ingesting oil particles without pointing out that visual harm is not the relevant criterion. Moreover, biochemical studies have shown that the effects of chemical contamination of some organisms have persisted long after ingestion. The statement that no permanent damage to plankton was reported from World War II oil spills (DES, Vol. 2, p. 85) is misleading since there were few observations made before, and even fewer during, the war.

The DES does not question whether enough is known to justify the conclusion the young stages of algae are more resistant to oil than animals (Vol. 2, p. 101). There is also no consideration of the effect of tar lumps which may be buried on beaches and which leach out toxic oil fractions for long periods and affect surrounding organisms.

As to the problem of food web magnification, the DES (Vol. 2, pp. 256, 661) fails to point out that the cited studies do not pertain to birds and mammals. It fails to consider food chain magnification in these animals, which include endangered species.

Pollution by Heavy Metals and Related Matters

The PDOD and the DES unjustifiably minimize the environmental effects of heavy metal pollution. In connection with formation waters, the DES does not consider the effects of the fact that the concentrations of minerals in discharged formation waters differ significantly from the concentrations in sea water. It also does not discuss the effects of oxygen deprivation resulting from the introduction of formation waters and the combined effects of such deprivation and the introduction of toxic minerals. The extent and time-frame of the spread of discharged formation waters is not analyzed.

In connection with the impacts of pipeline burial operations, the DES fails to specifically analyze the composition of the sediments which will be involved. This is particularly important in connection with possible pipeline corridors though dumpsites. Coagulation film anoxia resulting from pipeline burial is not treated.

The discussion of drilling muds is also deficient. The DES (Vol. 2, p. 4) fails to indicate the amount of such muds which will be introduced into the marine environment. The discussion (DES, Vol. 2, p. 8) of bioassay studies of chrome lignosulfate is cryptic and confusing. For example, no organisms are specified.

It is indicative of the Department's insensitivity to the heavy metal problem that it contemplates use of barite and ferrochrome lignosulfate in the Mid-Atlantic even though it states that their use has been avoided in the Pacific OCS for several years (DES, Vol. 2, p.7).

The DES treatment of heavy metal toxicity in general, including barium, chromium, iron, aluminum and others, does not provide sufficient toxicity level information. Moreover, the DES does not emphasize that the values for the copper, zinc and cobalt traces found in crude oils (Vol. 2, p. 673) exceed the values which have been shown to be significantly toxic for diatoms.

The problem of chronic low level pollution, including effects on various trophic levels and movement though the food web, is not adequately discussed. Moreover, in this connection more studies in the nature of CEPEX (Controlled Ecosystem Pollution Experiment), as well laboratory studies, are called for.

Effects on Fishing and Recreation

The Department's consideration of the effect of pollution on the fishing industry is deficient. For example, even a 10% reduction of fish in a given area could wipe out a small fishing operation for 5-10 years, at least in open waters. Again, the effect of chronic low level pollution is insufficiently considered.

The analysis of recreation and tourism is unsatisfactory. For example, when the DES discusses water-related recreation in New York (Vol. 2, pp. 391-395), it notes the large number of people who use the beaches near metropolitan New York City (e.g. Jones Beach). It is anticipated that day use of recreational areas in the Mid-Atlantic will increase markedly in the future (DES, Vol. 2, p. 555). Yet when the DES discusses tourism, it does not even consider the economic significance of day trips of less than 100 miles one way (Vol. 2, p. 408).

Air Pollution

The PDOD and the DES both fail to adequately consider air pollution effects. One example relates to refineries. The Department relies on an unjustified assumption which runs throughout the DES. It assumes that oil produced in the Mid-Atlantic will "replace" an equivalent amount of imported oil and concludes that no new refineries will required as a result of the proposed lease sale (DES, Vol. 2, pp. 165, 169).

This may be simply naive. If oil is produced in the Mid-Atlantic which is cheaper than imported oil and if energy conservation measures are not employed, the availability of the Mid-Atlantic oil itself may generate greater demand and the need for greater refinery capacity. The Department also chooses to ignore increased air pollution from the greater utilization of existing refinery capacity and the expansion of existing refineries, although Technical Paper No. 1, Economic Study of the Possible Impacts of a Potential Baltimore Canyon Sale, p. 57, discuss such utilization and expansion. The impact of gas processing plants on air pollution has also been inadequately treated.

As to the question of air pollution resulting from normal or accidental off-shore activities, one is flatly told that any such air pollutants will be carried away from land areas by prevailing westerly winds (DES, Vol. 2, p. 116). The fact is that winds from any direction have been encountered at all times of the year.

Land-use and Socioeconomic Effects

The Department's analysis of land use and socioeconomic effects is clothed in generalities. For example, the DES does not pinpoint where on-shore facilities are expected to be located so that the environmental, social and economic effects can be understood, nor does it indicate what the effects in each of the likely locations would be.

One point worth making here concerns the question of jobs. With characteristic latitude, the DES (Vol. 2, p. 179) asserts that at most 4,200 to 15,400 new jobs might result in the Mid-Atlantic area because of the proposed lease sale. It then adds the following revealing and yet unrevealing statement: "Not all of the increased jobs in the region would be filled by persons coming from outside the region." Thus, it is questionable indeed whether the proposed sale will provide jobs for a significant number of the region's unemployed.

It is also significant that one must examine Technical Paper No. 1 (pp. 195-198) to ferret out the fact that this study for the Department indicates that OCS activity will cause resources to flow out of Nassau and Suffolk Counties and parts of New York City.

Cumulative Effects

The Department inadequately considered the cumulative effects of pollution resulting from OCS activities in connection with pollution from other sources. It fails to analyze the effects of OCS activities on an already over-stressed environment. For example, with regard to marine pollution, the existence of dumpsites (DES, Visual No. 1) for chemical wastes, arsenic and other materials in the Mid-Atlantic area requires careful analyses of synergistic effects. If an organism has been previously exposed to sublethal levels of one toxicant, it is more vulnerable when exposed to another toxicant. In the case of copper and zinc, exposure to both results in a 5 times greater toxic effect than exposure to either one alone.

The discussion of air pollution does not take sufficient note of the difficulties of meeting air quality standards even under present conditions, especially in New York City and the adjacent area.

The inadequate discussion of the lease sale at issue is compounded when the DES mentions, but does not quantify, the cumulative effect of this lease sale and another one proposed in the Mid-Atlantic for 1977 (DES, Vol. 2, p. 304). The additional cumulative effects of the North Atlantic sales are also not analyzed.

PROGRAM MODIFICATIONS

The Department has not even structured its proposed lease sale and the national program to minimize the environmental effects. It has failed to provide for Government exploration prior to leasing. It has failed to provide that a lease may be terminated at any time if necessary to protect the environment. It has failed to state categorically that it will prepare environmental impact statements on all development plans submitted by lessees. It has failed to provide an adequate compensation system for parties injured by pollution or states upon which long-term costs will be thrust. It has failed to require the use of best available technology to prevent and mitigate environmental harm.

The Department has not even given adequate consideration to such measures. Regarding lease termination provisions to protect the environment, for example, the PDOD erroneously concluded that such lease termination provisions were not possible under present law (p. 22).

Although the DES (Vol. 2, p. 462), unlike the FES, now claims that the richest and most accessible areas will be leased first only to the extent the environmental considerations do not warrant delay, the Department has not altered its leasing schedule accordingly. The lack of coastal zone management plans and the lack of a meaningful state role in OCS development generally has also not been sufficiently considered.

Moreover, the Department generally has not given adequate consideration to delaying both this proposed sale and the national program. The sale and the program threaten severe injury to New York and other coastal states. Not all of the environmental and socioeconomic effects of OCS activity are known. However, more than enough is known to warrant revoking approval of the national program and calling off this sale. Indeed, the gaps in our knowledge provide another reason for doing so.* Unspecified baselines studies completed after leasing are not a substitute for delay.

Approval of the national program should be revoked and the proposed Mid-Atlantic lease sale should not be held.

---

*The Department seems more concerned about making sure that environmental information is kept from the public (PDOD, pp. 40-41).

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Ogden Reid,
Commissioner

February 20, 1976

Mr. Frank Basile
6 World Trade Center
New York, New York 10047

Dear Frank:

Enclosed please find New York State's technical comments on U.S. Department of Interior's "Draft Environmental Statement on Proposed 1976 Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States, OCS Sale No. 40" issued December 1975.

Sincerely yours,

Stephen L. Gordon
Deputy Commissioner

SLG/ctd
enclosure

State of New York

Comments On

U.S. Department of Interior's

"Draft Environmental Statement on Proposed 1976 Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States, OCS Sale No. 40"

Issued December 1975

February 17, 1976

VOLUME 1

1. Vol. 1, p. 57 - Surficial Shelf Sediments and Shallow Structure.
   This section is mis-titled. No structure is mentioned. The discussion is largely geomorphic. A better title would be more informative to a reader of the Table of Contents.
2. Vol. 1, p. 76 - Uplands - (c) Hydrology.
   This section should include a summary of the potential demand for groundwater by OCS related operations, and the effect this demand would have on water supplies.
3. Vol. 1, p. 82 - Figure II-18 is erroneous, many places in eastern Long Island are experimenting salt-water intrusion (ex. March Haven).
4. Vol. 1, p. 83 - Potential Geologic Hazards, a. Seismic.
   A discrepancy in the opinions of two sources as to the degree of seismic risk in the mid-Atlantic area is reported, i.e., risk is either minor or moderate.
   It is felt that resolution of this question requires more investigation. This section should include a summary of the research that is needed to resolve this discrepancy so that the seismic hazard may be adequately evaluated. A sea-bottom seismometer program integrated with the existing on-shore seismic stations may be called for.
5. Vol. 1, p. 84 - Potential Geologic Hazards, b. Shallow Fault Displacement.
   The discussion implies that if shallow faults are inactive they are not hazardous. Inactive faults and associated fractures can provide conduits for fluids, e.g., high-pressure gas encountered during drilling. Inactive faults should be respected as potential hazards.
6. Vol. 1, p. 86 - Subsidence of the ocean floor may be a serious problem because of the unstable nature of the bottom. Further investigation should be required

6. (cont.)

to determine whether or not (and to what degree) this might happen in that portion of the Middle Atlantic Bight nominated for sale.

7. Vol. 1, p. 89 - Scouring around the legs of the Texas Tower (Tower #3) on Georges Bank did occur. Scouring around the legs of oil platforms needs more consideration. One consulting engineer has contended that Tower 4 collapsed because of faulty design and construction which could not resist the severe weather conditions.

8. Vol. 1, p. 91 - The first sentence on the page alleges "scientific routing" of pipelines but does not explain what that is. In view of the very heavy fishing effort by large otter trawlers, and sea scallop and surf clam dredge boats, in the area to be traversed by the pipelines, it is felt that the pipes may not be protected from damage with subsequent rupturing and spillage of petroleum. The pipeline corridors must lie in an east-west direction whereas much of the fishing--hence, dragging of heavy gear on the bottom--will be conducted in a north-south direction.

9. Vol. 1, p. 95 - Air Temperature.

   The description given in the text of area "Hotel" did not match the chart (Fig. II-18) accompanying it. See chart attached for locations of areas. "Hotel" is a weather ship located at 38°N 71°W on which all the observations for the area "Hotel" are made.

10. Vol. 1, p. 98 - Precipitation.

    The climatological atlas which is based on the years 1931-1960 shows different precipitation minima and maxima than given in the report (Fig. II-19). The differences are small, however, and probably have no significant bearing on the general climatology of the offshore waters.

11. Vol. 1, p. 102 - Surface Winds.

    It is stated in the text that all the wind observations for the offshore waters except "Hotel" (38°N 71°W) were taken from ships-in-passage. Most of the data

11. (cont.)

looks reasonable except for the observed NE wind in the Quonset region during September; especially when the other surrounding regions except "Hotel" are reporting southerly winds. The observed NE wind in the Quonset region could possibly be attributed to a small number of years of data.

The ship "Hotel" has an observed E wind for both September and October. At first glance, these too look questionable but it is likely that they could be correct if, for the period of observations, the general circulation of the area favored high pressure systems moving eastward off the coast north of "Hotel." This would give "Hotel" E winds while the areas to the west and north had W and NW winds. Also, because "Hotel" is the farthest off the coast and closest to the Gulf Stream, any long period of storminess over the waters east of "hotel" would give them a higher frequency of E winds.

12. Vol. 1, p. 107 - Atmospheric disturbances.

This section is plagued with definition problems. The text states that two kinds of storms affect the area; transcontinental and tropical. Apparently, they meant extratropical and tropical. Contrary to the text, extratropical storms occur during all months of the year and tropical storms during the summer and early fall. Tropical storms are generally not more extensive (if referred to mean size in text) than extratropical storms. The text states that coastal storms are likely to be more severe than extratropical storms. Once again, their definitions are incorrect because a coastal storm is an extratropical storm. However, the incorrect definitions on the types of storms does not alter significantly the general climatology of the area as presented in this section.

13. Vol. 1, p. 138 - The document questions the work of Bumpus (a widely known and well respected oceanographer) with respect to the current patterns. However, there is no offer of other data to refute him. In the absence of other data, Bumpus' theory must stand until it is proven incorrect.

14. Vol., p. 213 - Biological Communities.

This is a good literature review of classical zoology and botany, i.e., it presents a good listing of expected resident and transient flora and fauna. Absolutely no quantitative information is provided, only presence or absence data. No discussion of population or community ecology is given, therefore, there is no way to interrelate the species to one another and to their physical habitat.

15. Vol. 1, p. 382 - Boating is seventh ranked in New York Statewide activities, however, considering number of participants on Long Island (Nassau and Suffolk Counties), boating becomes third in importance as is the case with the other coastal states discussed in this study. Perhaps a qualifying statement should be included indicating that "while New York Statewide interests rank boating seventh out of twelve activities, the availability of Long Island coastal resources make boating the third in popularity in this area".

16. Vol. 1, pgs. 385, 386 and 394 - The projections for future development of the Gateway National Recreation Area are not discussed in this study. This area should become a major attraction, including a major beach area open to the New York Bight. The proposed beach component of Gateway NRA at Breezy Point has not been mapped in this part of the publication or on the accompanying maps (Visual No. 1). While this map indicates the Breezy Point beaches would be State or locally run, sponsorship by the Gateway NRA project could easily make this one of the major public beaches in the New York City area within the study time framework. It is deceptive, therefore, to discuss the existing National Park Service efforts as receiving "slightly higher visitation rates than the National Wildlife Refuges". This situation is only correct at this time because of the relatively recent establishment of the Gateway NRA and the Fire Island National Seashore projects. Firm development proposals should be discussed and evaluated in this report.

17. Vol. 1, pages 391-395 - Improved water quality should substantially increase fishing opportunities in the New York Metropolitan area. Existing interests in fishing for recreation and as a protein supplement are already strong with many ethnic groups in the region. Non-whites, for example, participate in fishing at a higher rate than other segments of the New York State population. The fishing activities that would be pursued may be different than that pursued by sportsmen, however, indicating the need to concentrate on shoreline and charter boat fishing opportunities.

18. Vol. 1, page 393 - Both Gilgo and Captree attendance figures are included with Jones Beach (vs. "not available" shown on the table).

19. Vol. 1, p. 426 - The document states, "At the present time, little is known of the life history of these species." The species referred to are the spiny dogfish, rock crabs, and the red crab. This statement is completely in error. A.C. Jensen of the New York State Department of Environmental Conservation authored a report, "Life History of the Spiny Dogfish", published in 1965 by what is now the National Marine Fisheries Service. The report is concerned with the species in the Middle Atlantic Bight for the most part. Similarly, there are several excellent descriptive papers by Federal scientists on the several crabs.

20. Vol. 1, p. 433 -The section on surf clams contains one error and the rest of the material tends to be misleading. There exists a State/Federal Surf Clam Sub-council for the past 3 years which is working toward regional management of the fishery in the Middle Atlantic Bight. It is a very valuable fishery and has not received the attention it deserves; the EIS is very deficient in this respect. The surf clam is harvested at about 3 inches, not 5 inches as stated. Further, there are more recent publications than those cited in that section.

21. Vol. 1, General Comment

The water quality of New York waters, particularly Long Island embayments, was not adequately covered. The impression left by the report was that the chemical quality and bacterial quality of all Long Island waters was poor. This was because the report tried to summarize the assessment of three major areas in about a page of narrative and grouped Great South Bay and Moriches Bay, in their entirety, together.

It is felt that each south shore bay of Long Island should be discussed separately. As a minimum the breakdown would be Hempstead Bay, Middle Bay, East Bay, South Oyster Bay, Great South Bay (open section), Moriches Bay, Jamaica Bay, Lower Harbor, Raritan-Sandy Hook Bay and the remaining New York Harbor Complex.

In addition, to properly assess water quality, the biology should be discussed together with the bacterial and chemical quality of the resource and overall conclusions should be reached not only from quality indicators but as to impact on best usages.

A total revision of the OCS report should be made to discuss this in great detail as the unique value of the Long Island Resources justifies such an assessment.

22. Vol. 1, General Comment

More detail on the value of Long Island's wetlands, salt marshes, etc., should be included especially as it relates to wildlife habitat.

23. Vol. 1, General Comment

The barrier beach of L.I. should be discussed in detail as a separate ecosystem.

24. Vol. 1, General Comment

Long Island waters are an excellent fisheries which seemed to be glossed over in the Statement. Evidence of this is presented in market values of finfish and shellfish harvested as presented in the report. However, this is not fully elaborated on.

25. Vol. 1, General Comment

In the section concerning currents, the possibility of Gulf stream eddies have largely been overlooked. They do exist and often swirl near the project area. It is felt that further research in this area is warranted.

The information provided regarding current and drift data indicates that this parameter has not been researched sufficiently to advance spill-drift hypothesis terms such as "Very little other data to support his theory" and "it is believed" bear out this observation.

The description of Great South Bay makes the area seem anoxic and erroneously implies that the entire area is closed to shellfishing.

26. Vol. 1, General Comment

In the section of Vol. 1 concerning dredge spoil and mud on page 489 it is admitted that the volume of dredge spoil is dependent on economic development. Presumably, the discovery of O.C.S. oil and gas would lead to the expansion of Port facilities in the New York area resulting in increased dredging and spoil disposal problems. If harbors are dredged, adverse impacts may occur to the ground water system, benthic organisms and water quality.

Dredging in New York Harbor to accommodate super tankers could involve excavation in dangerous proximity to subway and highway tunnels.

27. Vol. 2, p. 8 - The presence of chrome-lignosulfonate in the drilling mud poses a serious threat to the abundant surf clam and sea scallop resources in the area. The EIS clearly states that the compound resists biodegradation and that the chrome will be concentrated by the shellfish. Such compounds containing heavy metals and other deleterious materials should not be permitted to be discharged into marine environment.

28. Vol. 2, p. 10 - The EIS acknowledges the potential for damage to bottom-tending fishing gear from wellheads and other underwater obstructions. But apparently BLM will accept such damage insofar as the petroleum devices will not be damaged because they are constructed to resist such impact. The cost of this damage to the commercial fishing industry should be considered.

29. Vol. 2, p. 15 - The report indicates that gravity separation methods will remove all heavy molecular weight and some of the low molecular weight. But on page 46, the solubilities of the low molecular weight hydrocarbons are shown to be more than can be neglected. These soluble components are the most toxic portion of the oil. This waste, therefore, should be treated at onshore facilities. (Are there any existing separating plants in this area?)

30. Vol. 2, p. 23 - The frequency of pipeline breaks is documented on page 23. How do the pipes involved in these accidents compare with the systems to be used in the mid Atlantic (i.e., were they concrete coated; were they buried?).

31. Vol. 2, p. 27 - indicates that only American crews and ships will be used in this operation, although it did not specify what assurances we have to assure this increased production in the refineries would result in a large amount of petroleum produced in a relatively small area, requiring shipment of refined products to their ultimate destination. Will this shipment be entirely via road and if not how can we be sure that foreign vessels will not be used in this

31. (cont.)

phase of transport.

32. Vol. 2, p. 32, Table III-11 - summarizes calculations of the probability of major oil spills due to natural phenomena (earthquake, hurricanes, 100 year storms). However, no explanation of what this actually means in number of occurrences is presented. A summary of numbers cannot be interpreted without a clear explanation.

33. Vol. 2, p. 41 - The report cites a study done by (Jeffrey 1973) indicating that deliverately spilled oil disappeared within 4 days. Max Bluner's study of the West Falmouth spill showed that 18 months later the oil was still spreading along the sea bottom and the area had not been repopulated. Obviously, absence of oil on the surface does not indicate that it is gone. This idea seems to pervade the entire report in reference to air pollution, formation water, drilling wastes, and minor spills. The report suggests that the pollutants will be diluted in a short time, out of site, out of mind, but definitely not out of the water column.

34. Vol. 2, p. 43 - Graph III-2 - does not include a scale, therefore, no quantitative measures can be made. There is nothing to indicate that there is less oil after 4 days than there was initially.

There is presently a model being prepared between the 40th parallel and the south shore of Long Island, but the report indicates that this report is not applicable to the lease area. Although the report does not include the lease area, the physical characteristics of the area south of Long Island may play an important part in the event of a northward drifting spill.

Present O.C.S. laws hold the owners of production rigs responsible for cleanup of oil, but not for damages that result. A drilling ship's liability would be limited to $100/gross ton or 14 million whichever is less

34. (cont.)

(it would probably be treated in the same terms as a tanker). This liability is not sufficient in an area as densely populated, and as dependent on the marine environment for its recreational and commercial resources as New York and New Jersey.

35. Vol. 2, p. 71 - B. Impacts of Offshore Oil & Gas Operations on the Natural Environment. 1. Water Quality.

This discussion indicates that oil is a principal component of drilling mud. No mention is made of oil as a component of drilling mud in the discussion of possible contamination of the ocean by drilling mud, Vol. 2, p. 3-6. The uses and composition of the oil based muds should be included in that discussion.

36. Vol. 2, p. 112-3. Geologic Hazard Impacts

Again it should be emphasized that inactive faults can act as conduits for hydrocarbons, especially high-pressure gas, hence are a hazard that needs to be evaluated.

37. Vol. 2, p. 143 - There is little (if any) support for the assertion that adult fishes would flee the spill area. The data simply are not available to permit anyone to make such a positive statement.

38. Vol. 2, p. 144 - There would be long-term damage to piers, jetties, and groins used as access by anglers. For example, in Sunken Meadow State Park, anglers and their gear was fouled with oil on the rocks that was deposited by a spill from the Long Island Lighting Co. offshore loading platform. The oil on the rocky substrate--plus any that fouled artificial fishing reefs--would reduce the productvity (and useability) of the structures.

39. Vol. 2, p. 162 - The report compares weather and sea conditions to those of Alaska and the North Sea. It states that these operations have been successfully carried out in these areas, but gives no information as to the amount

39. (cont.)

of oil and associated pollutants released to the environment. Further documentation in this area appears to be required.

40. Vol. 2, p. 169 - The refinery requirements that are expected to be generated by O.C.S. gas and oil are discussed. A very likely area for new plants would be the northern New Jersey area because of its proximity to the Port of New York and existing petrochemical dependent industries. This area is already overburdened with air pollution problems which are a function of the total volume of crude processed, not the number of plants, therefore, expanding the capacity of an existing refinery will have the same impact in terms of air pollution as building a new refinery nearby.

41. Vol. 2, p. 229 - It would be preferable to discuss a quantified estimate of the impact of various possible oil and gas related problems on recreation and tourism. The loss of participation, given specific circumstances, the accompanying loss of revenues from recreation industries, including number of jobs and businesses effected, land value, boat sales and impacts on other operations should be specified. These estimates should include short-term and long-term impacts.

42. Vol. 2, p. 230 - We would have preferred to see specific data on the number of days that actual beach clean-up efforts have taken as documented from actual events. We would also wish to know what mechanism would be utilized to rapidly undertake these clean-up efforts given our current responsibilities and resources for solving specific problems. Within our experience, no funds or coordinative mechanism currently exists to complete beach clean-up within a "matter of days". The technical operation may also be complicated by weather conditions.

43. Vol. 2, p. 231 - The prospects of an extended period of curtailed use of recreation areas and the effects of adverse publicity are difficult to assess, but may become the major impact of this project. We feel that the mechanism for review during project operations and possible mitigation has not yet been set up

43. (cont.)

to overcome possible deficiencies in any theoretical study. It is necessary to discuss procedures that may have to be undertaken to revise this study and to undertake new management or mitigating actions given actual operational experience.

44. Vol. 2, p. 277 - indicates changes in population and in commercial and industrial sectors as the result of discovery and development of oil and gas resources in the proposed Mid-Atlantic sale area would induce changes in the air quality of the affected areas in excess of changes that would occur with normal growth and development. It would probably lead to increases in suspended particulates, sulfur oxides, NO_x, HC, and CO. The anticipated increases, however, would be so small that no noticeable deterioration of air quality would occur. The estimated increase in population for the above region by mid 1980's are (5600 to maximum of 2000) which would be less than .01% in the noncommercial and nonindustrial areas and less than 1% in the industrial and commercial areas.

45. Vol. 2 , p. 287 - It should be underscored and emphasized that "all tracts will be considered to have the maximum effect possible on commercial fishing."

46. Vol. 2, p. 332 - erroneously indicates that the tidal wetlands law requires an E.I.S. and that New York State has implemented the State Environmental Quality Review Act. The State Environmental Quality Review Act is presently in the final stages of being implemented.

47. Vol. 2, pgs. 357 and 358 - It is recommended that a provision be made for additional non-geophysical surveys in areas of potential archaeological interests (i.e., sites of known wrecks and other documented sites of archaelogical interests). All geophysical survey records should be available for State and/or public review in addition to the review of the area Oil and Gas

47. (cont.)

Supervisor. The interpretation of anomalies identified will have to be done in conjunction with recognized authorities, programs impacting these areas of archaeological potential will also have to be reviewed by these same authorities. State Historic Preservation Liaison Officers and/or the National Park Service staff should be routinely consulted regarding these initial archaeological surveys.

48. Vol. 2, p. 359 - The admission by BLM that the biologically important areas "may not yet" have been located, is an important point. The State's proposed CZM study should help identify such areas before exploratory or production drilling takes place if sufficient time is provided.

49. Vol. 2, p. 361 - The report stresses the fact that pipelines are much safer than tankers in term of spill risk (stipulation #4). If approval cannot be obtained from the States for pipelines, the impact of tankering must be considered more carefully.

50. Vol. 2, p. 363 - The indented two-paragraph statement suggests that surveillance of buried pipelines will be done to "ensure that they remain buried." This statement raises the obvious question: What if the pipes don't remain buried? Knowing the unstable nature of the substrate in the area, the greater liklihood is that the pipes will not remain buried but will periodically be buried and unburied.

51. Vol. 2, p. 370 - The admission of lack of knowledge in the EIS about the fate of resuspended toxic pollutants is a clear indication that more study is required before any work commences on the OCS.

52. Vol. 2, p. 372 - Heavily contaminated beaches (or other shoreline recreational facilities) will not only remain unsuitable for recreation as long as they are coated with oil, the periods of clean-up, the necessary reorganization of lifeguards and other staff, the allocation of funds, the availability of revenues

52. (cont.)

may well put various recreational areas "out of business" for a season or for a prolonged period of time. The arrangements for beach clean-up may also take a considerable effort and pose various delays. Tar patches and other contaminants may be sufficient cause for reduced operations, attendance and revenues. These reductions in turn, would contribute to facility deterioration and neglect.

53. Vol. 2, p. 373 - The impact on salt marshes by spilled oil cannot be overemphasized. The work of Blumer et al., shows the long-term problem here.

54. Vol. 2, p. 375 - This statement related to improved near shore water quality has to be related to increased recreational and fishing demands discussed in Volume 1.

55. Vol. 2, p. 384, 385 - The information on these two pages clearly demonstrates the risks and hazards involved as a consequence of damage (NB: not possible damage, but expected damage) to our valuable living marine resources from spilled oil. However, the gratuitous comment, "The potential adverse impacts of these facilities can be eliminated through effective mitigatory action." Again, such a comment raises the question: What mitigatory action? And, does BLM honestly believe that the adverse impacts can be eliminated? If so, the BLM staff must be deluded about the sea, its living resources, and, especially, its forces as a dynamic entity.

56. Vol. 2, p. 395 - There is enough evidence to arouse concern about low-level spills and irreversible commitments of fish and wildlife. This is particularly so for an ecosystem such as the Middle Atlantic Bight which is petroleum free when compared to an ecosystem like the Santa Barbara Channel.

57. Vol. 2, p. 409 - Enactment of a CZM plan by New York State will put the State in a better decision-making position with more facts at our command.

58. Vol. 2, p. 465 - It is felt that there is merit in considering some form of research drilling, preferably by the Federal Government, prior to leasing. Much of the doubt and confusion in the minds of concerned persons is that we do not know the nature of the hydrocarbons (if indeed there are any) in the OCS lands. With samples at hand, collected under rigidly controlled operations, marine scientists could carry out all kinds of physical, chemical, and biological studies to learn with better certainty the impact on the marine environment of future exploitation of the hydrocarbon reserves. As it is now, we must indulge in highly speculative discussions.

59. Vol. 2, Biological Impacts

This is a superficial but fairly complete literature review of effects of oil and gas on individual species or trophic levels. As they are represented here, the original studies (both experimental studies in laboratories and descriptive studies at the sites of recent oil spills) were crude and simplistic, and could not have provided definitive explanations of mechanisms of effect of petroleum on biota. Alternatively the writers of this DES were overly simplistic and should be faulted for absence of quantitative discussions.

Despite the above comment, the writers may be faulted for uncritically using published studies and overplaying impacts. For instance, they quote the literature as not identifying any deleterious effects of heavy metals from drilling muds, yet they then conclude "More severe effects [than decreases in feeding efficiency and disturbance of respiratory processes] could be the toxicities to fish of trace metals..." (p. 108). On the premise that no discharged drilling muds contain hydrocarbons and the total amount of discharged toxic heavy metal compounds and drilling muds will be negligible, the toxicity to fish would be negligible.

59. (cont.)

As in Volume 1, there is no discussion of effects on communities of differential impacts on certain species in the various trophic webs. This is a critical flaw in the impacts section. Yet in the summary section (p. 267) the following occurs: "Whenever vegetation cover or habitat rendered unsuitable for one animal is replaced by another and associated fauna, the net change from a food chain viewpoint is minimal. Whenever replacement does not occur relatively quickly, the net change is greater." The first sentence is incredably naive and biased, and lacks any sensitivity for naturally occurring biota. The writers agrue for sparrows, starlings, and pigeons as the desirable avifauna. The second sentence does not make any sense.

The writers should inform themselves of the all inclusive definition of "wildlife" accepted by U.S. Fish and Wildlife Service, and not confuse the reader by equating wildlife to mammals alone or all four legged critters.

60. Vol. 2, General Comment

There has been no attempt to relate the weather conditions expected in the lease area to any possible oil spills that may result from the proposed oil drilling. There is also no mention of how potentially severe weather might affect the operations of the proposed oil rigs.

61. Vol. 2, General Comment

When the productive life of the field has expired, many of the supporting industries may collapse with a sudden rise in unemployment and lack of income to affected governments. If many workers and the oil related industries are located in a small area with a limited tax base the results could be locally serious.

62. Vol. 2, General Comment

Review of the draft environmental statement indicates that the impact from air pollution on the environment resulting from the offshore operations would be

62. (cont.)

minimal for the following:

1. Vol. 2, pg. 1 indicates that the proposed tract is located 54 to 108.5 miles east of the coasts of New Jersey and Delaware. Distance favors preservation of air quality.
2. Visual No. 2 of Vol. 3 indicates that the prevailing winds are from the west. Thus, any air pollution created by the proposed activity would be carried out to sea rather than towards the coast line.
3. Increases in on-shore population will not be a significant to promote air quality deterioration.

63. Vol. 2, General Comment

The reasoning presented in the DEIS is questionable in many areas regarding incidence of oil spills. For example, common methods of calculating tanker releases were not acceptable to the Department of Interior staff because they assume American Tankers and crews (better trained) would be used. A much more detailed explanation is necessary, otherwise this hypothesis must be disregarded.

64. Vol. 2, General Comment

CEQ maintains zero chance of oil spill from on-shore facility failure due to diking regulations. Oil spill records refute this position.

65. Vol. 2, General Comment

From what is presented, it does not appear that the frequency of oil spills from tankers, broken pipes, platform failures, blowouts, etc. can be made with great reliability. Further, the actual area impacted cannot be predicted. As a pipeline to New Jersey is proposed, areas of N.Y. and N.J. are subject to failures. Further, N.Y. would have increased tanker activity.

In addition, the potential damages that could occur from a catastrophic oil spill have not been presented for the N.Y. waters or any other waters.

65. (cont.)

The report only discusses the general impact of a spill but does not present actual damages to finfish, shellfish, wetlands, etc. This is of great concern since the report states that an oil spill impacting on one or more artificial fishing reefs in N.Y.-N.J. area would be most severe. Further, current and wind patterns on visual No. 2 indicate it is possible to impact N.J.-N.Y. coastal areas.

66. Vol. 2, General Comment

It appears, that very little baseline data has been gathered or is available in the tract area as a baseline environmental study is to be performed. This coupled with the obvious underestimating of coastal resources, lack of pinpointing areas impacted by an oil spill with frequency of occurrence, underestimates the "potential" environmental dangers of this activity.

67. Vol. 2, General Comment

The portion of the report which presented the most rational approach was that which discussed the alternative action of delaying this sale pending the completion of Coastal Zone Management Plans and baseline environmental studies.

GENERAL COMMENTS

68. General Comment - Individual tracts should be classified by the degree to which they are subject to natural hazards. For example, danger of storm damage, bottom scour, or geology-related mishap can vary with geographic position. This kind of evaluation can be included in matrix tables like those of Appendix 10, Vol. 2, or incorporated into the tables (II-4, Vol. 1, p. 92) that summarizes the geologic hazards.

69. General Comment - The interpretation of this data and the specification of exactly what effects oil and gas exploration and/or production would have on recreation still appears to be somewhat sketchy. It is felt that long-term impacts on recreation resources and the tourism, boating and recreational fishing industries have not been fully assessed. Short-term impacts have also been somewhat narrowly defined and the mitigating actions proposed are not directly related to the potentially effected recreational interests. The quality of Long Island and New York City beaches is of great concern to State, Federal and local agencies and a broad spectrum of private enterprises. Consequently, we feel that further study and program definition is required.

70. General Comment - A difficulty with the DEIS is that there is inadequate air quality data to conduct a scientific analysis. In Volume 1, page 211, it is stated that an overview of air quality for the region can be found in the final EIS of another project. Similarly, the air pollution impact proposed in Volume 2, page 280, refers to an air quality study conducted by BLM. In neither case are any excerpts from the reports included.

70. (con't)

The DEIS also fails to address the secondary impact of the project. The DEIS states that air pollution problems will be greatest from gas processing plants and indicates that, if drilling is successful, three to eight of these units might be built. No indication is given as to proposed locations. However, it is stated in Volume 2, page 281, that if such a facility was located in Nassau County the levels of various air pollutants would increase.

71. General Comment - It is stated in many places in the report that this oil is needed sorely in the mid-Atlantic states region; what assurances do we have that it will not be exported?

72. General Comment - The subject document is a much improved statement compared to that of September 4, 1975, but it is still far from what it should be. The errors, omissions, and misstatements cast a shadow on the document as a whole. One thing that is troubling is the source of some of the data extracted from the literature. In too many cases, instead of going to the primary literature, the authors have depended on digests, even though the original papers are available. To cite one example; many references are attributed to a two-volume document, "Coastal and Off-shore Environmental Inventory Cape Hatteras to Nantucket Shoals", edited by Dr. Saul Saila and published by the University of Rhode Island. It is a digest of information gleaned from many sources and has been criticized by some of the marine

72. (con't)

science community as being shallow in its coverage of material. The reader must remember that the document reflects the selection and editing by Dr. Saila and may not reflect the total information available in the original literature.

73. General Comment - There are too many unanswered questions raised by the EIS for OCS #40 for us to proceed with the action called for. Our marine environment is too valuable for us to plunge ahead--the action proposed by BLM should be delayed until we get a better understanding of some of the marine processes involved.

74. General Comment - The State Department of Commerce feels very strongly that the development of this resource should proceed as rapidly as possible, within the limits of reasonable environmental safeguards.

The development of environmental base data and the studies required to show that oil can be extracted with minimum damage to the environment are extremely time consuming. The Department of Commerce does not argue that they should not be undertaken, but is sympathetic to the Federal argument that leases for exploratory purposes can be granted while the studies are under way. Exploration, which will take some time, will simply show where oil is located. Overlapping this function with the preparation of the environmental studies will save a considerable amount of time in developing the oil deposits if the studies show that the risk can be minimized sufficiently.

74. (con't)

The main concern of the Department of Commerce in this matter is the maintenance of adequate fuel supplies so that industry will not be deterred from locating in the State because of fears of another oil embargo and because of the relatively higher cost of fuel.

75. General Comment - The New York State Department of State recommends delay of OCS Sale #40 pending:

(I) Implementation of CZM plans and,

(II) Completion of studies concerning environmental impacts of offshore mineral developments.

I. The Coastal Zone Management Plans for New York State have not yet been formulated. Identification of New York's coastal resources; determination of New York's goals and objectives, and development of management guidelines are important factors to be considered before the impact of the proposed sale can be estimated. In addition, delay of the sale would allow the mid-Atlantic states to discuss and possibly determine regional goals. State and regional CZM plans should be an important consideration in the decision on the desirability of the proposed OCS Sale #40. Therefore, the sale should be delayed.

II. The probable environmental-ecological impact of the proposed OCS Sale #40 cannot be estimated from the Draft EIS. A large quantity of isolated and often unrelated data have been compiled. Laboratory studies have been presented (Vol. I, pgs. 212-328; Vol. II, pgs. 67-111,

75. (con't)

623, 709) presumably to be used as a basis for determining the potential impacts of contamination (by drilling and oil spills on the ecosystem). The data presented is equivocal. Unfortunately, isolated laboratory studies do not always reflect responses in nature. We simply do not have enough information to predict the fate and significance of contaminants in the coastal environment. The BLM often acknowledges these two deficiencies in their DEIS (for example: Vol. I, pgs. 212, 214, 230, 243; Vol. II, pgs. 74, 79, 80, 86, 88, 94, etc.).

Species lists have been compiled that could be useful in the study of food webs, but there is no attempt to model even a simple food chain. Without a food chain model, we can only guess at the interrelationships of the various members of the coastal zone communities.

Energy budgets that show nutrient flow both within specific communities and across trophic levels are fundamental to understanding ecosystem dynamics. Without this understanding, it's impossible to assess the effects of various pertubations from offshore drilling on the ecosystem. The significance of food chain and energy flow analyses is illustrated below with a simplified model of fish food chain (although similar models could be made for beach or wetland ecosystems).

The Fish Food Chain

Fin and shellfish are a valuable commercial and recreational resource. The amount of fish in a given area is the result of

75. (con't)

a balance of food supply, environmental characteristics, and predator-prey interactions. Figure 1 is a simplified model that shows some of the relationships and how contaminants can affect the amount of fish available to man.

Phytoplankton are the primary producers in the sea. These microscopic plants convert the dissolved nutrients (with sunlight as an energy source) into plant material that can be utilized by non-fish herbivores and both juvenile and adult fish. The herbivores are a food source for non-fish carnivores and both juvenile and adult fish. The carnivores can also be a food source for the adult and juvenile fish. In fact, the adult and juvenile fish themselves can be a food source for other fish.

Some plants and animals are more useful as a food source than are others, because their food energy is more efficiently transferred up the food chain to the fish. Thus, the amount of food energy available to the desirable fish depends not only on the amount of light, nutrients, phytoplankton, herbivores, and carnivores present in the water column, but also on the particular species in each of these groups and the rate of energy transfer between each group to the fish. (The groups are shown in Figure 1 by boxes and the energy transfers by arrows). In addition, the relative importance of particular groups and energy transfers can change as a function of season, weather and location.

75. (con't)

The Regeneration Chain

In nature, fish numbers are depleted by predation, disease, or adverse environmental conditions that affect any one or all of the groups and energy transfers discussed above. These fish resources are replenished by mating, spawning, incubation of eggs, larvae, and finally maturation (shown by circles in Fig. 1). The regeneration process is triggered and controlled by a combination of visual, and environmental stimuli (e.g. temperature, chemicals in the water, food, etc.). Any interruption of this process will decrease the numbers of fish in particular year classes of the total adult population.

Possible Impacts of Offshore Drilling

Any development activity that affects either food energy transfer rates and the groups in the fish food chain or the fish regeneration processes will also affect the total fish resources available to man (Fig. 1).

For example two of the possible effects of offshore drilling are suspension of sediments and oil spills. The suspension of sediments from either the drilling itself or from construction of platforms and pipelines could: increase the turbidity of the water and therefore decrease the amount of light available for photosynthesis; resuspend absorbed chemical contaminants thereby reintroducing them into the food chain; and clog the filtering apparatus of the filter feeders (oysters, clams, some fish) possibly killing them.

75. (con't)

An oil spill could cause mortality at any level of the food chain (although the plankton are most vulnerable), and of the regeneration chain. The physiological functions, like feeding, mating, spawning, incubation of eggs, etc., are particularly vulnerable to oil spills and other contaminants associated with offshore drilling. The effects of an oil spill on an organisms' physiology may be long-term, so it may not show up immediately.

The potential effects discussed above are also a function of season, location, weather, concentration of the contaminant, residence time of the contaminant, and recovery time of the ecosystem. Therefore, to estimate the impacts of offshore drilling on the marine ecosystem we must know as a function of season and location:

1. the organisms present;
2. energy flux in the important food chains;
3. the long and short term affects of potential contaminants at various trophic levels of the ecosystem; and
4. the concentration and residence time of contaminants in the water column.

The BLM DEIS recognizes the importance of predicting the concentration and residence time of oil spills, but has not presented enough information to make this prediction. The DEIS discusses three models that attempt to predict the trajectory of an oil spill (Vol. II, pgs. 52-66), and points

75. (con't)

out that none of the three models can realistically portray the trajectory of an oil spill, because there are insufficient oceanographic, meterological and oil-water behavior data available. The problem is further compounded because the DEIS does not predict how the oil will be transported from the offshore wells to the refineries (i.e. by pipeline or by tanker and, therefore, the probable number of and volume of oil spills cannot be estimated (Vol. II, pgs. 118-133).

The location of the proposed drilling platforms and the pipelines to shore is in areas presently being used by trawlers (Vol. II, pgs. 118-150). The EIS points out that from 1967-1974, 92.3 percent of all the oil spilled from pipeline breaks is believed to be a direct result of ships dragging their anchors across a pipeline...Trawls may have a similar effect. The EIS has not presented enough information to assess the probability of pipeline breakage and other trawler related accidents (i.e. collision with a platform).

Summary and Conclusions

The spawning, feeding, and other physiological functions of fish are particularly vulnerable to oil spills and other contaminants associated with offshore drilling. The EIS did not present enough data to allow prediction of the impact of the proposed mineral development on the fishes of the New York bight. Much more data should be collected on the relationship between probable environmental perturbations as a result of OCS Sale #40 and the life cycles of the fishes to insure that the sale does not adversely affect the fish populations.

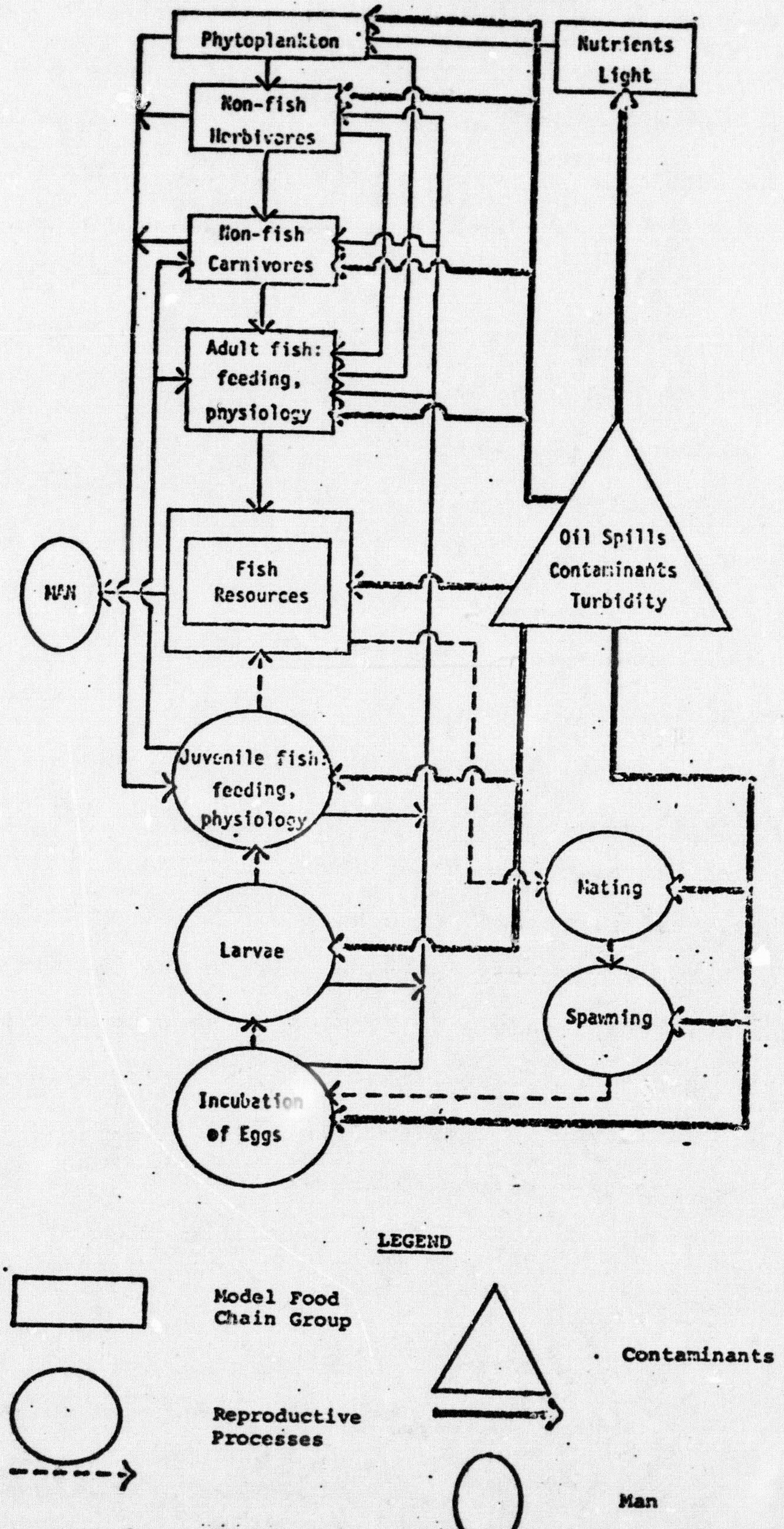
75. (con't)

The concentration and residence time of spilled oil or other related contaminants is extremely important to the ecosystem. However, without a better idea of the probability of frequency of oil spills and of the probable volumes that may be spilled, the fate and significance of spilled oil cannot be estimated.

The ability to predict the trajectory of an oil spill is important, because it implies an understanding of the transient forcing functions of the environment (e.g. wind, waves, currents, etc.). It is significant that the Draft EIS frequently points out that there are insufficient data to estimate the impact on the environment of offshore oilwells, if OCS Sale #40 is approved. Without a better estimate of the potential impact of development on the environment, and without a determination of goals and identification of management guidelines, it is felt that any decision to approve OCS Sale #40 is premature. Therefore, the New York State Department of State recommends that the sale be delayed until CZM plans and a better EIS are available.

Alternatively, the EIS could be broken into two parts: one that deals with exploratory drilling and the other (prepared after more data is collected) that deals with the production of the oil. This may be a more realistic approach in light of the data deficiencies discussed above.

Figure 1: Potential Impact of Contaminants on Fishery Resources


Phytoplankton
Nutrients
Light
Non-fish
Herbivores
Non-fish
Carnivores
Adult fish:
feeding,
physiology
Fish
Resources
MAN
Oil Spills
Contaminants
Turbidity
Juvenile fish:
feeding,
physiology
Mating
Larvae
Spawning
Incubation
of Eggs
LEGEND
Model Food
Chain Group
Contaminants
Reproductive
Processes
Man
Energy Flow

BEST COPY AVAILABLE

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DAVID J. BARDIN, COMMISSIONER
P. O. BOX 1390
TRENTON, N. J. 08625
609-292-2885

January 27, 1976

Curtis J. Berklund, Director
Bureau of Land Management
U.S. Department of the Interior
Washington, D.C. 20240

Dear Mr. Berklund:

This transmits New Jersey's comments on the Draft Environmental Statement on the proposed 1976 Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States (OCS Sale No. 40).

Section 102(c) of the National Environmental Policy Act requires your agency to develop before every action affecting the quality of the human environment a detailed statement on:

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

RECEIVED
JAN 29 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

100% Recycled

The human environment has been interpreted by the courts to include the social and economic environment as well as the natural environment, and businesses, communities, and aesthetic amenities as well as strictly public health and biological questions. Your Department, in opposing S.3221 in the last Congress, assured us in May, 1974, that each site-specific environmental impact assessment would consider all of these variables.

Regrettably, the draft before us does not live up to this commitment. Neither the energy supply implications, the socio-economic implications, nor the environmental implications of the proposed sale are analyzed effectively. There is time to improve the document before it becomes final.

More important, there is time to extend further your initiative to place into leases precise stipulations to ensure that long-needed reforms in the OCS program are accomplished even in the absence of new federal legislation. We are pleased that you have already accepted some of our earlier suggestions for incorporation in these stipulations. Specifically, we note your commitment that to "minimize disturbance of the environment and disruption of other uses of the OCS," the Bureau of Land Management "reserves the right to require that any pipeline to be used for transporting production from any lease to shore be placed in certain designated areas or corridors" (EIS, V. II, p. 362).

On this point, New Jersey is evaluating whether oil or gas pipelines crossing the Atlantic Coast beaches will pose unacceptable risks to public safety, to the tourist industry, or to other important resources of the Atlantic coast. Finally, we question whether this stipulation in fact totally reflects current agency policy. The California Coastal Zone Conservation Commission has been attempting to obtain a similar commitment from the oil industry for the transportation of crude oil from the Santa Ynez field. If the stipulation in the draft EIS for Sale No. 40 accurately reflects departmental policy, the agency should act to add this stipulation to other leases, such as those for the Santa Ynez field.

Worthy as this and the other stipulations currently in the EIS are, they do not go far enough. We strongly urge that you include several others, notably:

1. Stiff penalties for companies which fail to explore their leased areas promptly.

2. Full disclosure of pertinent information to all levels of government.

3. Strict and unlimited liability for direct and indirect costs or damages due to oil spills or other adverse impacts.

4. Mandatory unitization of exploration.

5. The further conditions and reforms contained in the pending Congressional legislation, including S.521 (amendments to the OCS Lands Act) and S.586 (amendments to the Coastal Zone Management Act), both of which were passed by the Senate last year, and the oil spill liability legislation, S.2666 and H.R.10756, currently pending in both houses. (Particularly important is an adequate oil spill contingency fund requirement.)

These steps should be taken before any Notice of Sale is issued.

These and other points are elaborated more fully in the attached comments prepared by my Department's Offshore Oil and Gas Task Force, in cooperation with other agencies of New Jersey state government. I am certain that the Department of the Interior is committed to improving the OCS program and fashioning it into an orderly and coherent effort which reflects the interests of all levels of government and the broad national interest as well. New Jersey stands ready to further assist in that effort.

Faithfully,

David J. Bardin

David J. Bardin
Commissioner

Enclosure: Detailed Comments on the Draft Environmental Statement on the Proposed OCS Lease Sale Offshore the Mid-Atlantic States. (OCS Sale No. 40)

cc: Manager, New York OCS Office,
Bureau of Land Management

STATE OF NEW JERSEY

DEPARTMENT OF ENVIRONMENTAL PROTECTION

OFFSHORE OIL AND GAS TASK FORCE

Detailed Comments on the Department of the Interior's Draft Environmental Statement on the Proposed Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States

January 27, 1976

TABLE OF CONTENTS

Page

Table of Contents i

Introduction ii

I. Flaws in Assumptions; Major Policy Omissions 1

- A. New Jersey's Economy and Its Relation to the OCS 1
- B. The Purpose of the Environmental Statement 2
- C. Alternate Bidding System 9
- D. Shaping Economic Development in a Way to Maximize Benefits 9

II. Direct Impacts from OCS-Related Operations 10

- A. Oil Spills 10
- B. Formation Water Discharges 11
- C. Drilling Mud and Cuttings Disposal 12
- D. Pipelines 12
- E. Onshore Facilities 12
- F. Waste Disposal 12
- G. Air Quality 13

III. Recreation/Tourism: Socio-Economic Impacts 15

IV. Industry: Socio-Economic Impacts 17

V. Biological Impacts 20

VI. Geological Considerations 24

STATE OF NEW JERSEY

DEPARTMENT OF ENVIRONMENTAL PROTECTION

OFFSHORE OIL AND GAS TASK FORCE

INTRODUCTION

These comments on the Department of the Interior's Draft Environmental Statement entitled "Proposed Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States - OCS Sale No. 40" (EIS) were developed by the Offshore Oil and Gas Task Force of New Jersey's Department of Environmental Protection. The responsibilities and membership of the Task Force, which was established by Commissioner David J. Bardin on August 28, 1974, are described in Attachment 1. The Task Force was assisted in developing these comments by several other agencies of state government.

During the preparation of these comments, the Task Force and other agencies also evaluated Technical Paper Number 1, Economic Study of the Possible Impacts of a Potential Baltimore Canyon Sale, which was released at the same time as, and referenced in, the EIS, as well as other related materials. Consistent with the procedures established for the review of these documents, we reserve the right to submit additional written comments on or before February 12, 1976.

Our intention is, by these comments, to evaluate and offer comments on the draft EIS, and more importantly, on the assumptions behind it. We have endeavored to contribute to the goals for the management of the continental shelf as stated by the Department of the Interior, namely:

1. Orderly and timely resource development,
2. Receipt of fair market value for the public's resources, and
3. Protection of the environment.

We agree with these goals, but unfortunately are forced by our analysis to conclude that they are not embodied in this draft environmental impact statement.

Finally, we would be pleased to provide additional information, or to elaborate points made in the detailed analysis which follows.

Glenn Paulson

Glenn Paulson, Ph.D.
Assistant Commissioner for Science
and Chairman, Offshore Oil and
Gas Task Force

January 27, 1976

I. Flaws in Assumptions; Major Policy Omissions

Last February, the draft programmatic EIS (DES 74-90) on the entire accelerated leasing program was the topic of hearings in Trenton and elsewhere. We were very critical at that time of certain assumptions made in that document, as well as the lack of presentation of certain alternative policies and their careful evaluation. We have found similar omissions and flaws in this site-specific EIS as well. This is disturbing, since New Jersey has a great stake in ensuring that a sound, orderly, and comprehensive program governs the exploration for, and production of, potential oil and gas resources off our shores. Such a positive program should contain several key elements; these are outlined in Governor Brendan T. Byrne's testimony, which is being submitted separately. Because the EIS does not reflect the economic characteristics of New Jersey, its economy, and its communities, we will outline the factors leading to the competing and often conflicting interests in New Jersey as they will potentially be affected by the OCS program.

A. New Jersey's Economy and Its Relation to the OCS

New Jersey is a heavily industrialized state. The largest industry in the state is the petrochemical industry, with over $4 billion per year in annual production. (This can be compared with a total state product of about $57.5 billion per year.) The petrochemical industry needs crude oil to provide raw materials for its refineries. It also needs petroleum products and natural gas feedstocks as well as energy supplies for its own operations. Finally, this industry, which ranks as the sixth largest in the nation, provides both energy resources and other products not only to New Jersey's residents, commerce, and industry but to many other states as well. Let there be no mistake; New Jersey is already playing a major role in the nation's energy and petrochemical economy.

Our second largest industry is tourism, which amounts to almost $3.5 billion per year. This industry depends in large part on aesthetically pleasing coastal areas. Equally important, tourism depends on the normal functioning of important ecological systems which underpin the integrity of coastal beaches, wilderness areas (such as the Brigantine National Wildlife Refuge), and other areas of aesthetic and biological importance.

Agriculture, the third largest industry in the Garden State, accounts for slightly under $2 billion per year. It needs adequate energy supplies for its farms and for its food handling and food processing facilities. It also needs pesticides and other products that are derived from petroleum, and it needs energy resources to transport the food from where it is grown to where it is needed.

Other important commercial activities may also be affected, both positively and negatively, by outer continental shelf energy resource development off our shores. Many New Jersey industries are short of natural gas, most notably the glass industry. Offshore gas deposits may in future years help at least to reduce somewhat the projected shortfalls in natural gas supplies.

This multitude of both complementary and conflicting interests are in the minds of citizens throughout New Jersey.

B. The Purpose of the Environmental Statement

This EIS, a part of the year-long process preceding a proposed lease sale, is prepared under the authority of the National Environmental Policy Act (NEPA). NEPA was designed by Congress to provide a mechanism whereby federal actions could be evaluated for their potential impacts, both positive and negative, upon the human and natural environment. This was done in order to provide the citizens of this country with a means for deciding whether a proposed federal action would have impacts to warrant its continuance or cessation.

NEPA requires a federal agency to describe, in as broad a scope and as completely as possible, the proposed action with its attendant impacts. The draft EIS on Proposed OCS Sale No. 40 does not measure up to the standards set by NEPA. Generally, we have found that the mundane details are dealt with adequately, but that the broad policy questions are treated either naively or not at all. This conclusion is based both on our review of the EIS and related documents as well as our careful monitoring of the offshore leasing program over the years.

The document under discussion is an unfortunate example of how the spirit of NEPA may be perverted. The EIS ignores almost all major issues, while at the same time it presents in great detail fact after fact, datum upon datum. This abundance of minutiae highlights the paucity of comprehensive policy thinking, careful evaluation of alternatives, and reasoned judgement behind the EIS.

The major flaw of the EIS is that it is based upon a series of unfounded, unrealistic and unexplained assumptions. These assumptions in turn serve as the mold from which the economic and environmental impacts are formed. The result is an EIS that does not adequately reflect or recognize the characteristics of competing interests in New Jersey. In addition, the EIS does not accomplish the task mandated by NEPA. The EIS does not adequately consider the impacts resulting after oil and gas reach land, nor does it consider the implications of current federal laws and regulations, let alone potential changes in those laws and regulations. For example, the EIS fails to consider the many possible changes in federal leasing policy and in gas and oil regulations and allocation programs which could have very major economic and environmental impacts both in New Jersey and the Mid-Atlantic region as a whole. Finally, the EIS presents a very limited series of alternatives to the proposed action, with all the alternatives chosen from the extremes of the spectrum of possibilities.

NEPA requires a consideration of the possible alternatives to the proposed action. In this case, because of the intertwining of economics and environment, and the relation of federal regulation to OCS production, a much more comprehensive and realistic series of alternatives should have been evaluated. Further, many uncertainties presently exist as to the indirect economic effects of OCS oil and gas exploration and production; these should all be evaluated before the near-future course of action is finally decided upon later this spring.

The EIS is generally based on either maximum or minimum values for determining impacts, rather than reasoned, most probable numbers. This results in a distortion of the effects projected, and an unrealistic evaluation of impacts and alternatives. An example of this is the estimate of undiscovered recoverable resources. The BLM has used recoverable resource estimates of 2.6 billion barrels of oil and 12.8 trillion cubic feet of gas as their "high" case, which are based on earlier U.S. Geological Survey (U.S.G.S.) estimates. Later estimates which indicate a more restricted resource base are not used.

Another example, from a different area, is the air pollution impact of the onshore gas processing facilities. The EIS assumes a concentration of contaminants in the gas stream, and a degree of gas clean-up, which give rise to very substantial emissions of sulfur dioxide. In fact, much lower contaminant concentrations are likely, and much higher gas clean-up efficiencies are possible. As a result, air pollution impacts are magnified by the EIS, and realistic evaluations are excluded.

These examples are not meant to indicate that the extremes of any spectrum should be ignored, since it is conceivable that such extremes may occur. Rather, it is meant to suggest that the relatively more probable occurrences should be evaluated fully, in order that the more likely impacts can be determined. In most cases, the more likely impacts will be the basis for future decisions by both the public and private sectors. The major exceptions to this are catastrophic accidents, such as major oil spills, where the potential worst case must be a major factor in responsible and responsive policy making. The EIS presents either the largest and worst impacts, or smallest and least, thereby hindering policy preparation, reasoned analysis, and sound decision-making by all interested parties.

Another major flaw in the EIS is the assumption that oil produced offshore will replace an equivalent quantity of imported crude oil. The reasons for this assumption are neither explained nor justified. The EIS does not discuss whether or not this assumption of substitution is projected to hold true for the productive life of the field. Nor does it describe the administrative or legal mechanisms, if any, which would assure that substitution will occur as assumed.

This assumption of exact substitution colors the resulting onshore impacts. For example, as a result of this assumption, no new refineries are projected to be built in the Mid-Atlantic area. The EIS is unclear on the question of expansion of present refinery capacity. It appears that refinery expansion has been considered as possible, but no expansions were included in the economic model. Neither does expansion correlate with substitution of OCS for foreign oil. As a result, the effects of new or expanded refineries are not considered. This both flaws the economic analysis and ignores the environmental problems which may accompany such development.

In general, a disregard of onshore development permeates the EIS. There is little or no discussion of the possibilities of secondary and tertiary industrial development being encouraged by the oil and gas coming ashore. In fact, many facilities necessary to refine, clean, use or transport these resources are ignored or described in a very cursory fashion, as though these activities would have no impact whatsoever.

This lack of consideration of secondary and tertiary development is compounded by the failure to assess the impact of possible changes in federal policy and administrative regulation. Current laws governing the allocation of gas from the Baltimore Canyon mandate that New Jersey will not receive a disproportionately large share of any offshore gas. The EIS does not address this issue at all. Even worse, it hints at the opposite. (V. II, p. 182.)

> "Production of gas from this proposed Baltimore Canyon sale would result in fewer curtailments of gas contracts in the Mid-Atlantic region."

Also (V. II, p. 183):

> "A heavy burden has been placed on the Mid-Atlantic coastal region by the curtailment of deliveries, inability to add new gas customers ... Gas production from this proposed sale could serve to alleviate future gas problems in the Mid-Atlantic coastal region to some degree ..."

The effects of possible changes in federal regulation of natural gas are omitted entirely. Such changes could alter the flow of OCS gas drastically, and result in profound changes in the manner in which this gas is used onshore. Most notably, changes in regulatory schemes could result in the development of major petrochemical facilities in New Jersey as well as throughout the Mid-Atlantic region.

The econometric study (Technical Report No. 1, hereafter termed the economic report) accompanying the EIS makes several assumptions about the location of onshore facilities without an explanation of the underlying logical bases for these assumptions. These locational assumptions have a significant effect on the subsequent analysis of impacts.

It is assumed that onshore operations bases will be built in Atlantic County, New Jersey (1979); Kings County, New York (1983); Cape May County, New Jersey (1985); and Monmouth County, New Jersey (1988). The EIS further assumes that four pipeline land terminals will be built in Atlantic County, New Jersey (1980); Monmouth County, New Jersey (1981); Cape May County, New Jersey (1982) and Ocean County, New Jersey (1983). It is not clear why these specific counties, to the exclusion of other possible counties, were chosen. Nor is it clear why some counties were chosen for onshore operations bases, some for pipeline land terminals, and some for both types of facilities. Furthermore, it is not clear how the timing of these facilities was derived, nor why in some cases onshore operations bases come before pipeline land terminals and in some cases after.

Many of these assumptions appear ill-founded and unrealistic. The resulting analysis therefore diffuses onshore impacts, underestimates local impacts, and provides no help to the states in planning for onshore development. It would seem that a more realistic set of siting allocations would have taken explicit account of state and federal environmental constraints, as well as local desires and industrial plans.

Another unsubstantiated assumption concerns the rate at which equipment, manpower and supplies will be available for the entire accelerated program. The EIS offers assertions rather than reasoned analysis in its attempt to show that men, equipment and supplies will be immediately available for the eighteen lease sales scheduled for 1976, 1977, and 1978 so that an approximate resource assessment can be made in a timely manner. If Interior possesses proof that current shortages in tubular steel, for example, can be eliminated in a timely manner, it should include them in the final EIS.

The State of New Jersey and others have suggested changes in the leasing program which would allow more extensive exploratory drilling with the same amount of equipment, such as leasing by geologic structure rather than by small, arbitrarily designated tracts. To increase the flow of capital into exploratory work, reliance on the front-end bonus bid should be replaced by other bidding systems so that more money could be put to work drilling instead of flowing into the federal treasury. This step would almost certainly allow new companies to enter the field as well, and thus increase competition in the heavily concentrated energy industries. Independent natural gas distribution companies should be involved in OCS work, but the large up-front bonus payments effectively bar them from any meaningful participation.

Elimination of bonus bidding should be accompanied by the use of other techniques that will pay to the public treasury over the life of a field a full and fair share of the value of the energy resources. The result of the recent California and East Texas sales can be taken to show that the current uncertainties surrounding the OCS program may be leading to lower bonus bids in any event.

As part of an accelerated exploration effort, the federal government should itself become more active in the exploratory phase. New Jersey has called for a federal role in exploration for some time; the U.S. Senate (in the form of S.521) has already acted to authorize such a program.

Even short of federal exploration, the drilling of stratigraphic test wells suggests another mechanism clearly within the authority of Interior to implement. If these wells were drilled into potential reservoirs (instead of in a place where dry holes are virtually guaranteed to be the result), a maximum amount of information as to the possible extent of the resources would be obtained at no cost to the taxpayer and without the government having to dispose of its interest and control by the granting of a multi-year lease before any information from drilling is available.

The basic goal of an accelerated exploratory effort is to provide solid information in the shortest possible period of time on the location and potential extent (or absence) of OCS energy resources. This information is needed by both executive and legislative branches of government at the local, county, state and federal level so that intelligent decisions can be made regarding the production, impact, and utilization of these resources. Sound management at all levels (including in the private sector) demands such information. The current program simply does not provide it in a timely manner.

For example, New Jersey, particularly South Jersey, has suffered shortages of natural gas in recent years. The available geologic evidence suggests that the Baltimore Canyon Trough, if it holds anything, is somewhat more likely to contain natural gas than crude oil. This possibility has raised unrealistic hopes in some quarters that New Jersey will be entitled to a disproportionately large share of that natural gas, and that New Jersey will become the Mid-Atlantic equivalent of Louisiana, with an overabundance of natural gas to fuel industrial growth.

The EIS should have addressed this issue; instead, it is not discussed at all. In fact, current FPC policies governing the allocation of interstate gas (which any Baltimore Canyon Trough supplies would be) mandate that, given the distribution systems currently in place, New Jersey could not expect to obtain a disproportionately large share of any offshore gas. By not addressing this issue at all, Interior has allowed these hopes to be sustained in the minds of many. The final EIS should clearly state that future offshore gas supplies delivered to pipeline systems will be allocated by the Federal Power Commission, and that no state will receive an unduly large share. Given the mandates of the National Environmental Policy Act, this failure to even attempt to describe the fate of natural gas supplies - and their effect on the regional economy - is very disturbing.

As a corollary, there are other serious omissions as well. The issue of direct sales of natural gas by producers to ultimate consumers is not discussed. The implications of the use of components of hydrocarbon supplies other than methane as feedstocks for petrochemical plants are not discussed. The implications of the currently proposed Congressional changes in the Natural Gas Act are not discussed, etc., etc. If the EIS is to be a useful planning and decision-making tool for federal, state, and local governments, we must know what possible development may result from Congressional proposals to deregulate the price of interstate gas or, on the other hand, to extend regulation to the intrastate market.

To show the shallowness of this part of the EIS, it is sufficient to note that, as far as natural gas is concerned, the EIS and its accompanying economic analysis follow the potential natural gas flow only from the production platforms offshore to gas processing facilities onshore--and no further! There is no discussion of hardware and routes necessary for subsequent distribution of the gas, let alone the omissions of regulatory policies and options mentioned above. In fact, even the gas processing facilities themselves are not adequately described.

The EIS is not any better in the policy and technical implications of additional crude oil supplies. We find here again, as we found in the programmatic EIS last February, the assumption that one barrel of OCS crude will substitute (exactly and precisely) for one barrel of imported crude. This is so naive an assumption as to be ludicrous. First, Project Independence notwithstanding, no federal authorities currently exist to guarantee that this goal can be achieved. Second, of necessity, such an assumption also assumes (but the EIS does not state) many things about the future--among them, various growth rates in the use of petroleum products, future changes in costs of these products, both in absolute terms and relative to other potential energy sources; the effect of energy conservation programs; and many other alternatives. And third, it ignores the fact that the United States imports more oil now than it did before the Arab oil embargo. If, in fact, it appears that the price of domestic oil supplies will continue to be regulated - certainly a fair possibility given the mood of Congress - Interior need only look as far as the recent experience with natural gas development for an example to illustrate the fact that OCS crude will not substitute one-for-one for imported crude. For the past five years, the overwhelming majority of additions to natural gas reserves has been in the intrastate (unregulated) market. Such experience would seem to indicate that imports may continue to provide a substantial share of the petroleum used in the United States, and, therefore, OCS production may be an addition to, not a substitute for, imports.

Just as for natural gas, the selection of only one of several alternatives for crude oil production means that the potential implications of all other alternatives are not considered. For example, suppose that the new OCS crude adds to the net existing inflow of crude into the Delaware Bay refinery complex. Refinery expansions (or, less likely, totally new refineries) might then be needed. The positive and negative implications of this are not considered at all, including the possible effects that larger quantities of petroleum-based feedstocks might have on the petrochemical industry generally. For another example, suppose that through other mechanisms the amount of imported crude oil drops more than the amount of the OCS crude delivered. This may have serious negative implications for the petrochemical industry, another possibility that is not addressed in the EIS. By basing all of its analysis on a single set of assumptions the EIS has placed all of its intellectual eggs in one basket, to the detriment of reasoned analysis.

Another area omitted is the pending change in the existing petroleum allocation program administered by the Federal Energy Administration. For an EIS to ignore such potentialities shows callous disregard for the energy supply situation of New Jersey and its sister states in the Mid-Atlantic region. If it were not for the fact that these considerations were also ignored in, for example, the California site-specific EIS, we would be tempted to suggest that, from an energy supply perspective, Interior is writing off the energy needs of the Mid-Atlantic states. As it is, it merely shows the continued disinclination of Interior to focus realistically on the legitimate needs of coastal states and its inability to differentiate among the real needs of various states and regions.

This then, is an EIS that does not live up to the mandates of NEPA in its evaluation of the proposed OCS lease sale. The assumptions are ill-founded, the analysis is flawed, and the alternatives discussed are insufficient in scope.

C. Alternate Bidding Systems

The present leasing system is structured in a way which gives the larger oil companies unfair, and very possibly unlawful, advantages. New Jersey has repeatedly called for the elimination of the heavy reliance on the bonus bid; see for example, Governor Byrne's July 25, 1975 testimony before the Ad Hoc Select Committee of the House of Representatives. Leases should be offered for sale on some type of a royalty or production sharing basis, thus giving the government a share in both the risk and benefits of OCS production while permitting smaller energy companies to compete without having to come up with large bonus bids. Interior should also separate the right to explore for the resource from the right to produce it. This makes sense from the local, state, and national perspective.

D. Shaping Economic Development in a Way to Maximize Benefits

The New Jersey economy juxtaposes the vital concerns of the energy intensive petrochemical industry and the coastal tourist industry. The need to maintain and improve the existing economic climate of New Jersey is great. To ameloriate the impacts of high energy costs and the adverse effects of decreased energy supplies, New Jersey has long recognized the immediate need to know the extent of the resource base in the Baltimore Canyon Trough. Simultaneously, the multi-billion dollar tourist industry and the concerns of the local communities that exist all year on the basis of a three-month economy cannot be disregarded (as is done in the EIS). The existing recreational and other uses of the coast are compatible with reasonable economic development activities. New Jersey waterways and open lands contain water channels and land sites suitable for staging facilities and other onshore development which will not harm other existing economic activities.

Only limited job opportunities are directly involved in the exploration of the Outer Continental Shelf. The residents of shore communities, including their entrepreneurs, will refuse to be run over rough-shod by an OCS program that lacks respect for the integrity of the tourism industry that has supported the southern coastal communities of New Jersey for many decades. Strict and comprehensive liability provisions must accompany offshore oil activities. To ask that tourist counties risk economic disaster from a major oil spill without adequate insurance provisions is unacceptable.

The economic implications for New Jersey demands that care be taken to maximize the benefits that can accrue to the State. The analysis of impacts in the economic report provides no better understanding to coastal residents, businesses, or governments on how to accomplish this than was previously available. In design and manner, it would seem that no thought was given to developing a realistic basis for analysis. The assumptions made were not selected for the purpose of fully assessing economic impacts, both positive and negative.

We now turn to comments on specific sections of the EIS.

II. Direct Operational Impacts from OCS-Related Operations

A. Oil Spills - The EIS data on pipeline spills (V. 2, p. 23) in the Gulf of Mexico attributes 92.3% of the oil spill volume from this source to accidents involving ships' anchors. The Mid-Atlantic OCS is an intensively fished area, and is also in the immediate vicinity of ship traffic for two of the largest and busiest ports in the world. Moreover, the EIS includes insufficient data on vessel movements or collision rates. Predictions of the probability of spills from pipelines, from vessel collisions, or from vessel-platform collisions are absent. Rather than considering possible impacts from increases in vessel movements, the EIS assumes that since imports will decrease on a one-for-one basis as offshore production begins, vessel movements will decrease after an initial increase during the exploration and early development phase. Both of these assumptions are simplistic and insufficient.

Experience has shown that oil travels closer to the wind velocity vector than the 3-4% of the combined surface wind and current velocity vector presented in V. 2, p. 52. Accordingly, the landfall timetable based on the model appears to be in error. The bias created by the over-estimated landfall time for an offshore spill precludes adequate assessments of coastal or nearshore impacts. In addition, drift bottles do not have the same wind sheer factor as an oil slick.

The spill reporting procedure (V. 2, p. 777) is not complete. All spills should be immediately reported to the U.S. Coast Guard and State agencies as well. Federal and State oil spill legislation does not provide that notification of the District Supervisor satisfies notification requirements for spill reporting. The EIS also does not adequately discuss funding and initiation procedures for cleanup operations (V. 2, p. 276).

Little consideration is given to the effects of the suspended or sinking portions of a crude oil spill (V. 2, p. 42). Benthic effects, particularly in commercially valuable bivalve beds, could be significant. Sublethal dosages may have minimal biological impact but severe commercial impacts, if spilled oil taints clam or scallop tissue.

The statement also gives little consideration, if any, to the effects of day-to-day minor oil spills on vertebrate or invertebrate physiology and behavioral patterns. The "mitigation by dilution" assumption in V. 2, p. 139 may not be valid when considering the biological community directly associated with platform structures.

B. Formation Water Discharges - The possible environmental impacts of formation water discharges are inadequately addressed in the EIS (V. 2, p. 69, 81). Since a new biological community will be constituted in the immediate vicinity of platform structures, is it valid to assume that dilution is an adequate method of treatment?

Sublethal concentrations of formation water constituents may exert subtle effects on physiological characteristics or behavioral patterns of existing adult and larval populations, However, no data is presented to assist in evaluation of possible impacts in this area.

C. Drilling Mud and Cuttings Disposal - New Jersey agrees with proposed OCS Order No. 7 provisions prohibiting discharge of drilling muds or contaminated drill cuttings (V. 2, p. 321) onto the Shelf. However, no impact assessments are presented concerning alternate disposal methods of contaminated cuttings or drilling muds. This is a significant omission by virtue of the potential volume of the wastes generated. An alternate approach to the disposal problem is presented elsewhere in these comments.

D. Pipelines - The most critical impacts of oil or gas pipelines are directly associated with pipeline routing and the establishment of corridors. As the location of pipeline corridors will either mitigate or magnify impacts associated with pipeline construction, operation, or ruptures, efforts should be made to include the State's geological knowledge in the location process due to the State's familiarity with nearshore and coastal geology (V. 2, p. 345-346). Pipeline corridors should be designed to avoid significant shellfish and finfish resources so as to minimize impacts of the burying procedure and accidental ruptures possibly resulting from fishing or shellfish harvesting operations. Corridors should also bypass exposed rock formations and hazardous dump sites (V. 2, p. 92), as additional impacts would be generated by maintenance, possible spills, or repairs in these areas.

Staffing and funding for the proposed nearshore and coastal pipeline corridor studies are not addressed in the EIS (v. 2, p. 239).

E. Onshore Facilities - Although there are recognized indications of natural gas potential in the Mid-Atlantic OCS area, the EIS is exceptionally weak in assessment of onshore impacts associated with natural gas processing and storage facilities. Other than recognizing the necessity for these facilities (V. 2, p. 183), the EIS provides only token assessments as to pollution, economic, and aesthetic impacts. (V. 2, p. 242, 272-274, 280-284).

F. Waste Disposal - The quantities generated and the intended means of disposing of the spent acid recovered from production well acid injection are not specified. The potential magnitude of wastes generated by an oil spill cleanup operation resulting from a projected operational accident and the provisions to dispose of such wastes are not described. Since the potential expansion of refineries or petrochemical plants is not considered, the quantities of chemical and hazardous wastes that could result from any expansion of existing refineries and concurrent expansions in the petrochemical industries are not assessed. Given existing problems with these wastes at current levels in New Jersey, this is a serious omission.

G. Air Quality - The onshore facilities assumed for New Jersey may be consistent with the State Implementation Plan provided these facilities are planned and built without increasing pollutant concentrations in areas where there are contraventions of the National Ambient Air Quality Standards (NAAQS). However, the projected increases in emissions in certain areas might exhaust their non-deterioration increment.

The evaluation of the impact of the proposed activities on emissions was appropriate, given the uncertainties involved. However, the draft EIS does not distinguish clearly between emission rates and concentrations, and estimates were not made of the effect on ambient pollutant concentrations. Specific comments are as follows:

a.) The projected doubling of SO_2 emissions in Atlantic County would not be expected to produce any contravention of the NAAQS there with proper design and siting of facilities. However, the resulting increase in SO_2 concentration would probably exhaust the increment of non-deterioration in a Class II area under present Federal regulations, possibly limiting future growth in that area. Likewise, if any counties were redesignated as Class I, the proposed activities might very well exhaust the allowed increments there.

b.) The emission inventories for Atlantic, Ocean, Cape May and Monmouth Counties in the economic report were not compared with other emission inventories prepared for these same counties, such as the inventories providing the basis for the Environmental Protection Agency's designations of air quality maintenance areas in New Jersey. A comparison of the emission inventories for 1975 in the economic report with those used as the basis of EPA's designations shows some substantial differences, with the economic report usually giving the lower value. Furthermore, a new inventory being prepared for Atlantic and Ocean Counties indicates that the inventories originally used for these designations may be low in many cases.

c.) The economic report indicates that a single gas processing plant would produce 34,000 tons per year of SO_2 if emissions were uncontrolled and 1,736 tons per year if controlled, and that two plants would produce 87,000 tons per year if uncontrolled and 3,482 tons per year if controlled, assuming peak production of gas. (We are mystified as to how two identical plants can have more than twice the emissions of a single plant.)

These values were based on assumptions about the H_2S content of the gas and efficiency of the emission controls (economic report, p. 219). Attempts to verify the calculations revealed serious ambiguities in the statement of the assumptions. However, there appears to be no question that the values are based on a "worst case" situation, that is, an H_2S content of the order of 50%, and in the case of controlled emissions, about 95-96% control efficiency (as from a Claus plant without tail gas treatment). Tail gas treatment could reduce the emissions to less than 90 tons per year per plant. But even a plant emitting 1,700 tons per year from a stack with a height of the order of 100 feet would most likely not cause a contravention of the SO_2 standards in an area with low background concentration.

d.) Although ambient air quality data are available for three of the four counties in the economic study, no attempt was made to project changes in concentration from the change in emissions.

e.) The review of the impact on air quality, (V. 2, p. 277-84), in particular the reference to the economic study on p. 280, does not distinguish clearly between emission rates and concentrations.

f.) The following textual errors with respect to air quality were noted in V. 1:

(1) p. 40 - No final transportation control plan was prepared by New Jersey for the parts of New Jersey adjacent to New York and Philadelphia. EPA prepared and issued the plans for those areas.

(2) p. 208 - The ambient air quality data for 1974 showed more contraventions of the standards for suspended particulates than indicated. The annual geometric means for suspended particulates were lower than the primary standards in all areas except Newark (133 ug/m^3), Carteret ($70ug/m^3$) and Jersey City (82 ug/m^3). In addition, the standard for the maximum 24-hour concentration was contravened in Bayonne, East Orange, South Amboy, Woodbridge, South Brunswick and Secaucus.

(3) p. 41 - Class III refers to all air quality standards, not just secondary standards.

(4) p. 42 - Coke ovens, not coal ovens; curtailment of incinerator use rather than elimination of incinerators.

(5) p. 208 - Periods for judging contraventions of the carbon monoxide standards are eight hour, not three hour.

(6) p. 205 - Suspended particulate networks are not given.

It is not good practice to imply that prevailing winds of one direction will remove pollutants, since such winds do not prevail continuously. (V. 2, p. 116)

III. Recreation/Tourism: Socio-Economic Impacts

Assessments of possible negative socio-economic impacts are disproportionately minimized throughout the EIS. An adequate assessment of adverse impacts in a coastal recreation and resort-associated economy is not possible if developed on the basis of the implicit assumption that no offshore oil spill will wash ashore. The EIS does not adequately address the seasonal nature of the Jersey shore economy, and thus minimizes the severe impacts which would result from the landfall of such a spill during the early summer.

Certainly, the economic consequences of a major oil disaster represent one of, if not the most, serious potential impacts of the proposed leasing of tracts on the Mid-Atlantic OCS. But the EIS, while emphasizing the economic benefits of recreational use of the coastal areas, should not ignore the social implications of the loss of recreational opportunities as a result of a disaster related to the proposed leasing program. Millions of people who would normally satisfy their recreation desires at the shore resorts could find themselves without suitable alternatives. In order to obtain a true perspective of the possible consequences from a recreational viewpoint, better visitation estimates should be derived.

The demand data extracted from the State Comprehensive Outdoor Recreation Plans (SCORP) of the five coastal states presented in the EIS provide an indication of the extent of recreation use of the shore-related resources, but does not provide an accurate estimate. As the draft EIS states, the data are of limited use because of the lack of comparability and other reasons. The results of a household survey conducted by the National Marine Fisheries Service to determine the magnitude of participation in saltwater recreational activities is inadequate for this purpose because it applies to just the five Mid-Atlantic States; many of the visitors to New Jersey's beaches originate outside of that area (e.g., Pennsylvania, Canada). Finally, the attendance figures of federal and state recreation areas, while providing some indication of the magnitude of the visitation, are not reliable estimates of the total visitation.

The exclusion of day trips (less than one hundred miles one-way) from the analysis of the economic impact of tourism is a very major omission. This significantly lowers the figures in the EIS for the economic aspects of recreational use of the coastal resources.

While the EIS states that day-use information was excluded because of the lack of available reliable data, it supports its action by stating (V. I, p. 408) "... exclusion does not affect the validity of the displayed estimates inasmuch as the cumulative economic significance of short distance day trips is minimal in the context of the remainder of the tourism activity". While the State does not have figures to refute this statement, the tremendous day-use visitation that is experienced by New Jersey's shore resorts generates substantial and significant revenues; exclusion of this day-use activity from the computation results in a severe understatement of the economic impact of recreational use. Traffic volume data for the Atlantic City Expressway and other major highways connecting the Philadelphia area to the southern shore resorts support our contention that there is tremendous day use within 100 miles travel distance which does have a substantial economic impact.

The economic analysis focuses solely on tourism and ignores the economic aspects of other forms of travel, particularly convention-induced travel. This omission results in an understatement of the economic benefits of the coastal recreational resources. Significant environmental degradation of a resort region would probably result in a substantial reduction in convention activity and business receipts.

Any understatement of the economic benefits of the coastal recreational resources is magnified in the economic analysis by the application of multipliers to determine the secondary impacts on business receipts and employment. In order to weigh properly the benefit and potential costs of the proposed leasing program, accurate economic estimates must be provided.

Finally, the results of the economic analysis were not adequately incorporated into the analysis of the overall potential impact of the program. The EIS repeatedly states that a major oil disaster could adversely affect the recreation industry of an area. However, the impacts are not expressed in economic terms.

In conjunction with the economic aspects, the EIS does not mention who would bear the economic losses resulting from an oil spill. The full potential impact of the proposed leasing program on New Jersey cannot be considered without figures indicating the magnitude of the direct and indirect economic losses that residents and businesses in New Jersey could suffer as a result of a major oil spill or other disaster related to the gas and oil exploration program.

There are two major deficiencies in the recreation and open space resources map. First, it does not identify the coastline (beach area) as a major recreational resource. Secondly, it does not include all of the recreational resources that could be impacted by a major oil disaster. The potential impact area might extend up a river as a result of tidal influence. More specifically, the Tuckahoe and Port Republic Fish and Wildlife Management Areas (which are not presently shown on the maps) would probably fall within the impact area.

There are also several problems with the EIS relative to recreation. In Table II-76, demand data from the 1973 New Jersey SCORP is misrepresented. The table indicates that demand is expressed in numbers of individuals, whereas the data is in fact expressed in recreation days. One day is actually equivalent to two individuals.

In the tables appearing on pages 381 and 399, the report indicates that demand data for New Jersey could not be obtained for certain activities. Although the exact figures did not appear in the New Jersey SCORP, they could have been easily calculated using the available information.

IV. Industry: Socio-Economic Impacts

Assessment of the positive socio-economic impacts in the EIS is unrealistic, vague, and contradictory. The previously mentioned assumption that OCS oil will not be an additive source of crude oil is extremely unrealistic. This assumption would imply that there will be no OCS-induced refinery expansion (V.2, p. 169), a frozen absolute petroleum demand, and no induced growth in petroleum end-product consumption. Is it a coincidence that this unrealistic picture minimizes adverse environmental impacts?

The "barrel for barrel" replacement assumption is at least partially contradicted in the EIS itself (V.2, p. 185). Petrochemical industry expansion is predicted in association with refinery expansion and ready sources of feedstock. If there will be no net increase in absolute amounts of crude oil as a result of OCS development, what justification is there for projecting additional refining capacity and petrochemical plant expansion? The EIS further states that regional shortages in crude oil may be alleviated by OCS production (V.2, p. 184).

The grossly overstated positive impacts in V.2, p. 202-203 are not supported by the basic assumptions nor data presented in the EIS. The total OCS-related population increases for the Mid-Atlantic region as a whole would be a maximum of 20,000 persons, less than 1% different from base case levels (V.2, p. 180), yet changes in retail sales activity are projected as substantial should OCS development proceed (V.2, p. 191).

Inadequate consideration is devoted to the social and economic consequences of siting natural gas processing plants in "low stress" counties, although this is advocated as mitigating adverse air emission impacts. Induced acid rainfall, haze, and noxious odors would have greater relative aesthetic, visual, and economic impacts on truck farming or primarily residential/recreational counties.

The EIS is very vague as to the source of revenues projected to accrue to local communities. Unavoidable impacts in the form of stresses exerted on transportation facilities, public utilities, and educational systems are not adequately discussed. Will the additional dollars projected (V.2, p. 182,193) really enter the regional economy? Are revenues and employment projections justified? Who will or should fund the additional administrative monitoring, and surveillance activities required by OCS activities? The EIS is mute on these important questions.

The EIS gives token attention to possible additive or synergistic economic impacts associated with other related energy development programs. Deepwater ports, liquified natural gas terminals, and refinery expansion or development are not realistically considered as to the magnitude of associated impacts.

Since it is unlikely that four operations bases and four pipeline terminals will be sprinkled randomly throughout the New Jersey-New York coastal area, the study would be more useful if it more fully described the impacts of each facility and perhaps combinations of pairs of them.

The economic model used provides data in many useful categories. In its concluding chapter, the study hints at the model's ability to produce additional information with direct implications for land use (p. 259). Such information would be useful if included in the final EIS.

Several questionable siting assumptions are evident in the draft EIS. Among the suspect assumptions, the most questionable one is that the more under-developed counties are the best potential sites for OCS-related development.

The EIS concedes that OCS staging areas in Ocean, Atlantic, Cape May, Salem, and Cumberland counties could facilitate severe economic stress, given the limited infrastructure and lack of heavy industry in such areas. The EIS's solution to this potential adverse onshore economic infrastructure impact is a wide dispersal of OCS-support facilities in any OCS production scenario greater than the low discovery case. Whereas the Department of Environmental Protection's interim land use guidelines for implementing the state's Coastal Area Facility Review Act (CAFRA) identify Atlantic City as a possible OCS staging area, the EIS maintains that Atlantic County could experience severe economic stress, particularly because of a lack of needed infrastructure. We disagree.

Furthermore, the EIS maintains that OCS production in the moderate to high scenarios would require additional staging area locations due to Atlantic County's inability to absorb high levels of new industrial and related growth. We disagree with this, as well. An alternate (and potentially more realistic) assumption that developed industrialized areas present the best opportunities for OCS onshore development without severe economic impact, points to areas already heavily industrialized as more desirable OCS staging area sites. In addition, the use of OCS onshore development to stimulate the economy of depressed areas has received only cursory attention in the draft EIS.

The Department is particularly concerned about the real estate and land use picture painted by the EIS. The shift of population and retail trades into the coastal area may stimulate development shifts to new coastal activity nodes such that the character of the recreation-oriented southern Jersey Atlantic shoreline would be permanently disrupted. An example of this reasoning is the assumption (page 185) that chemical industry expansion should be channeled into low density-low environmental stress areas such as the coastal counties in South Jersey.

A technical inaccuracy in the EIS may shed still more light on the adverse impact or irreversible commitment of coastal land resources on OCS-induced onshore development. County-level estimates of the acreage required to accommodate OCS-induced population growth are based upon quarter-acre lots. This assumption is invalid. Studies of zoning in New Jersey's coastal counties cite lot sizes averaging at least one-half acre and in many cases nearly three quarters of an acre. Thus, total residential acreage requirements may approach 5,250 acres, not 1,750 as the EIS maintains.

V. Biological Impacts

Coastal and Nearshore Areas. A major deficiency detected in the EIS is the basing of biological impacts on minimal hazard conditions, without consideration of maximum impact situations. Assessment of coastal and nearshore impacts is predicated on the assumptions that..."offshore spills from the vicinity of the proposed lease tracts would probably not affect the nearshore or coastal environment", and "The probability of spills from pipeline breaks is given in Section III A.2 and would be small for the area." (V.2, p. 75). No consideration is given to the possibility that there could be maximum effects. The EIS tends to become a defense of OCS development rather than an objective presentation of possible impacts.

The EIS grants that damage to a year class of fish having planktonic larvae could occur on a regional basis as a result of pipeline spills (V.2, p. 85). No consideration is given to the resultant impact of the loss of a year class of one or more fish species. The EIS presents the loss of one reproductive cycle as a minimal impact; however, heavily utilized fish stocks could be severely depleted as a result of the disruption or elimination of one or more successive reproductive cycles.

Offshore Areas. The deficient assumption that dilution will adequately mitigate any adverse impacts associated with hydrocarbon or formation water discharges imposes a biased viewpoint on all impact assessments. (See comments elsewhere in this review). Although commercially valuable fish species such as cod, haddock, and hake are identified as deepwater spawnees with planktonic larvae, inadequate discussion and data are presented on impacts of continuous sublethal concentrations of oil or formation waters in the vicinity of platform structures (V.2, p. 107-108). We agree that avoidance behavior will be practiced by adults, but larval stages are far more susceptible by virtue of their limited mobility.

The Draft EIS does not adequately describe important biological communities and living resources within the Mid-Atlantic Coastal States. The statement fails to recognize important biological processes which occur within the offshore leasing area, near and onshore communities. Some of the important deficiencies of the EIS are as follows:

a. There is no map of wildlife distribution.

b. There is no description of species, quantification of abundance, or distribution of offshore and onshore waterfowl and marine birds.

c. There is an inadequate description of certain vegetation types, including the Pine Barrens, wetlands (including eelgrass), rare and endangered plants, and timber stands important to the New Jersey lumber industry.

d. There is an inadequate description and location of sport and commercial fin fish breeding areas, anadromous, estuarine, or marine.

e. There is a lack of statistical data on foreign fishing efforts in New Jersey coastal water.

f. There is an inadequate assessment of loss of habitats from OCS development (wetlands, uplands, etc.).

g. In general, there is a lack of appreciation of the ecological and aesthetic values of biological resources to the region to the people of New Jersey, and to the tourist industry.

The following are specific comments on biological issues keyed to the three volumes of the EIS:

Volume I, Section II

p. 133. "In the vicinity of Long Island, the coastal drift current is in a westward direction along the coast of New Jersey and the Delmarva peninsula." This is misleading.

p. 214. "Micro-flora...very inadequately known." Additional materials on this topic are available from Rutgers University and NOAA.

p. 243. Include New Jersey as a state where the distribution of benthic marine algae is not well documented.

p. 274. Fish do not "defy categorization"; many categorizations are available.

p. 274. To state that the winter population of fish in the OCS area is "poor" is completely false. Many coastal and estuarine species are known to winter in OCS waters. Lobster and sea scallops are intensively fished. There are many foreign trawlers. We suggest consulting NOAA and the Grosslein groundfish surveys, not cited in the references. Completely overlooked is the inshore-offshore seasonal migration of estuarine and marine fishes and crustaceans.

Another deficiency of this statement is the complete lack of description and quantification of oceanic bird populations which inhabit offshore waters. These may well be the most heavily impacted species from an oil spill, but "only 5-15 percent of these birds killed will wash ashore" (p. 261).

p. 276. Estuaries are productive of adult fish, serving as vital nursery areas, feeding areas, and a source of forage fish which serve as food for other species.

p. 278. Alewife are not to a "large degree" dependent on freshwater spawning areas, but completely dependent.

p. 279. Table II-53 does not adequately describe "spawning areas". Some examples: Striped bass-omitted are Delaware River and Chesapeake Bay; American shad use "sandy or pebbly shallows" in the Hudson and Delaware Rivers; Atlantic halibut "spawn on bottom". More specific information is readily available on this.

p. 291. Menhaden are overlooked as a forage fish.

p. 292. Table II-57 contradicts page 290 which states fish have "generalist feeding habits". The table shows fish feed rather specifically, depending on stage in life cycle, locality, or season.

p. 299. Coastal vegetation as described is highly generalized and incomplete. The uniqueness of New Jersey Pine Barrens and the 109 southern and 14 northern species of plants which reach the limits of their distribution in this same area are overlooked. The numerous species of rare and endangered plants are overlooked as are the distribution of species important to the lumber industry.

p. 307. Fig. II-56: Coastal "zones" are not shown, only tidal marshes are indicated.

p. 308. Common species of plants omitted include: Phragmites, Typha Zanzania, Peltandra, etc. for marsh, and Iva, Baccharis for salt water marsh. Zosteria and Ruppia are submerged rather than marsh vegetation.

p. 314. Marine and Coastal Birds. There is no attempt to describe species, distribution, abundance, critical breeding and wintering areas. Figures shown have mislocated the Barnegat National Wildlife Refuge, and overlooked Raritan and Barnegat Bays and the Delaware River as concentrating points.

p. 319. The threat to endangered and unique species of wildlife has been underestimated. Species listed as "threatened" are nearly as vulnerable as those listed as "endangered," but these have not been described.

p. 421. Commercial and Sports Fisheries. This section is well done with good statistical documentation of domestic harvest weights, numbers, and dollar values. However, the intensive foreign fishing throughout OCS waters may equal or exceed domestic efforts. Consequently, underestimation of the value of the renewable resources of the OCS is very probable. Underestimation may also be true for some species, such as sea scallops which are harvested off New Jersey but landed in Massachusetts.

In addition, the direct landing value of surf clams for New Jersey 1973 was $2.7 million, but this industry adds close to $10 million to state economy annually.

Volume II

p. 73 A range of 50 to 570 miles of pipelines is not really an estimate.

p. 98 What will be the quantitative loss of surf clam and lobstering areas? These important Mid-Atlantic resources should be discussed specifically. What will be the impacts, which are now occurring, to commercial fish through seismic survey operations, in lost gear (lobster pots, time, harvest), etc.?

p. 140. There is presently sport fishing activity in offshore and canyon areas for tilefish, marlin, tuna and swordfish.

p. 253. Impacts on onshore vegetation could include establishment of firebreaks, which would lead to vegetative succession (change, loss of rare or unique plants, and loss of timber to the lumber industry. There is no projected loss of upland habitat.

p. 254. Impacts on submerged vegetation (eelgrass and widgeongrass) are not discussed. These are very important species to waterfowl and bay scallops, both important in New Jersey.

p. 263. There are 44,000 waterfowl hunters in New Jersey contributing $5 million annually to the state economy. A large oil spill could seriously impact this.

p. 265. "Sea birds undeniably receive the greatest impacts" but there is no quantification of abundance or species present.

Volume III

Visual #1

Barnegat Bay National Wildlife Refuge is more extensive an area than shown. Wharton, Bass River, and Lebanon State Forests are not shown along with other State fish and wildlife management areas. Regarding potential recreation and open space areas, what were the criteria used? Why are more extensive areas shown for Delaware than New Jersey?

Visual #3

Shrewsbury Rocks, a nearshore outcrop located southeast of Sandy Hook, is not shown. This is a very important sport fishing and lobstering area. Urban areas of Monmouth, Ocean, Atlantic and Cumberland Counties are not shown. Freshwater marshes along Great Egg Harbor River and the Delaware River are not shown.

Visual #4

The Oak-pine complex is highly generalized. The marsh area shown at Perth Amboy is incorrect, along with an omission in the Raritan River Basin. Dune areas that have been shown are much less extensive. Eelgrass beds are ignored.

Visual #5

1. Raritan Bay and nearshore areas not shown for menhaden.
4B. Hard clams: much of the actual distribution in New Jersey water is not shown, or is confused with soft clams.
2. Surf clams: (a multi-million dollar industry) many important nearshore beds are not shown.
Most nearshore and wintering fin fish areas have been omitted.

VI. Geological Considerations

The text mentions the fact that the Trough may have originated from the down-dropping of a fault block. However, Fig. 11-3 (V.1, p. 56) shows only a single fault on the eastern boundary of the Trough.

The sedimentary interpretation of dolomite limestone, etc. behind the ridge is complimentary with the sedimentary interpretation from work done on many well samples. This interpretation, if correct, indicates that hydrocarbon potentials may exist or have migrated well up-dip so as to be present within fifteen to twenty miles offshore New Jersey. These would probably constitute some gas accumulations in stratigraphic traps. The point is that hydrocarbons may be much closer to shore than previously anticipated. This possibility is subtly acknowledged in the EIS (V.1, p. 565).

Lower Cretaceous sediments probably represent the best prospect for petroleum in the Trough as stated on page 53 of Volume 1, since it correlates with one of the known petroleum horizons in the Gulf of Mexico, known as the Woodbine Horizon. Upper Cretaceous and some tertiary horizons probably contain reef structures that may be potential productive zones. The possible existence of structural traps is not mentioned as a possible mechanism for trapping petroleum.

Salt domes offshore New Jersey constitute potentially thick pay zones as mentioned on page 57 of Volume 1. However, the possibility that these domes also constitute zones of potential hazard (such as excessive geopressures) is not mentioned. There is also no mention in the last paragraph on page 57 of limestones and shales in the section below the Quaternary sediments. Limestones and probably shale have been noted in some deep wells along the Jersey coast. These horizons become possible reservoir horizons for petroleum. The EIS states (V., p. 62), that Schlee implies large offshore sand and gravel deposits may be related to the ancestral Hudson drainage. It is just as probable that these deposits may be related to the ancestral Delaware River drainage.

Geologic Hazards. The Mid-Atlantic OCS environmental hazard rating by four oil companies (V.1, p. 25) indicates the lease area is rated seven on a scale of ten, ten being most hazardous. This rating indicates that there are indeed hazards involved, since oil companies would typically tend to de-emphasize potential hazards. This may in fact be reflected by the data shown in Visual #3. In addition, Visual #3 does not show one of the accepted major faults that trends somewhat east-west offshore From Monmouth County and probably connects with the large fault shown in the northeast quadrant of Visual #3.

Water depths over the Baltimore Canyon Trough are stated (V.1, p. 51) to be from 20-6000 feet. This implies, considering the 125 mile width, that there are probably some relatively steep slopes at certain places within the Trough complex. These steep slopes might possibly present construction or potential bottom movement problems with respect to pipelines.

The implication (V.1, p. 72) that certain age sediments have prevented marsh foundation from Alloways Creek north along the Delaware River is a misconception. This condition is due to influences that have no relation to resistant qualities of the sediments.

Environmental incidents resulting in damage to equipment (V.1, p. 89-90), regardless of faulty repair work, result in impacts. Affixing blame and making hindsight decisions do not correct the original problem. Pipeline and platform construction, maintenance, and repair work will be very important in the coastal zone offshore New Jersey. Storm action with sand movement may develop a potentially hazardous situation. The last paragraph on page 89 adds credence to the hypothesis that a shifting bottom can contribute to potentially hazardous situations. Further comments on page 90 of the EIS indicate the problem of shifting sands.

We agree with the admission (V.1, p. 91) that additional information is needed to gain knowledge on hazards.

The statement that natural gas is more prevalent as a potential hazard in the Gulf of Mexico than the North Sea (V.2, p. 111) indicates that the Mid-Atlantic area is comparable to the Gulf of Mexico because its geologic stratigraphy is more similar to that of the Gulf than that of the North Sea. All of the geologic hazards presented on pages 111-115 are real hazards, and must be treated as such, due to the frontier or unknown nature of the Mid-Atlantic OCS.

Sand Migration. Ridge and swale topography (V.1, p. 61) on the shelf bottom could present problems in selecting pipeline corridors which would be least influenced by storms or bottom currents.

Water. Table II - 1 (V.1, p. 78) indicates that the total yield of all aquifers on Long Island is 16-32 million gallons per day; yet 1965-1968 ground water pumpage from Nassau and Suffolk counties alone averaged about 314 million gallons per day.

The EIS discusses New Jersey aquifers (V.1, p. 79) and states that water availability data from aquifers is not presented because of difficulties in finding the relevant literature. This statement is incorrect, as most coastal plain aquifers have been studied in sufficient detail by the U.S.G.S. Ground Water Branch.

Nothing is shown in Fig. 11-16 (V.1, p. 82) in New Jersey relative to salt water intrusion, yet the U.S.G.S. has commented on salt water intrusion in several of their reports. On page 83, it is stated that there is salt water in certain formations in New Jersey. If oil exploration and production should proceed up dip or towards the coast, there is at least the possibility that ground water resources could be affected in some way.

Seismic Hazards. The statements regarding seismic risks and occurrences (V.1, p. 84) are somewhat contradictory. At one point the Mid-Atlantic OCS seismic hazard risk is minor, in another it is considered moderate, and in another the classification is dubious due to insufficient information. The Mercalli scale is a poor indicator, as it only considers damage reported concerning man-made structures.

The discussion of shallow fault displacement (V.1, p. 84-85) mentions faults south of the Hudson Valley that may be associated with a deeper fault, possibly an extension of the Kelvin fault. Although there may be no offshore effects, there have been some peculiar geologic phenomena in the last twenty years in New Jersey which may be attributed to seismiscity and possible faulting.

Technology. Potentially high unknown geopressures (V.1, p. 88) are considered unlikely, but they may be present in zones of faulting or salt diapir compression.

Discussion of drilling mud and cuttings discharged into the sea raises the question of whether cutting discharges will be restricted only in those areas delineated as important shellfish or fin-fish areas. It appears more appropriate not to discharge overboard except in those areas that are barren of bottom-dwelling creatures.

The EIS mentions that the average well depth is expected to be approximately 15,000 feet into the Lower Cretaceous (which is postulated to be the most promising horizon). According to the U.S.G.S. cross-section which is based on the best available seismic data, it appears that it would take 12-15,000 feet of hole (Fig. 11-3, V.1, p. 56) just to reach the Lower Cretaceous. In general drilling work, depending on the thickness of the section, it would appear that the average depth of hole in the Trough area to penetrate or properly explore the Lower Cretaceous would require an average depth of 17,000 to 18,000 feet. This then, increases the proportionate amount and discharges of drill cuttings, mud, etc.

Pipeline corridor studies (V.1, p. 87) will be crucial, as evidenced by bottom conditions experienced during actual construction work for other pipelines.

Spill prevention plans developed for pipelines should be reviewed by professional engineers (V.1, p. 44) as well as by certified geologists since many engineers are not aware of the hydraulic qualities of the coastal water-bearing formations.

STATE OF DELAWARE

COMMENTS ON DRAFT ENVIRONMENTAL STATEMENT

OCS Sale No. 40

The State of Delaware has reviewed the Environmental Impact Statement for Lease Sale No. 40. The general and specific comments represent the thinking of the following groups: the Governor's Office, the Attorney General's Office, the State Planning Office, the Department of Natural Resources and Environmental Control, and the State Geologist. Reviews of preliminary drafts of this EIS have been previously presented to the BLM. The following questions represent the unanswered questions from Delaware's preliminary reviews as well as questions which result from BLM's redrafting of the preliminary draft EIS.

GENERAL REMARKS

1. Legal Integrity

The Attorney General's Office is currently researching the legal considerations for oral and written comments on the Sale #40 Draft Environmental Statement. A subsequent lawsuit would most likely attack NEPA deficiencies in approving a Development Plan without an Environmental Impact Statement, rather than the adequacy of the EIS on the lease sale.

2. Format

The comments made in the October 6, 1975, Memorandum from David Keifer to Frank Basile regarding making the report more readable are still appropriate: "We understand that an environmental impact statement must exhaustively examine all the various scientific factors, but this could be handled by a simple matrix where the type of environmental impact could be plotted against the reports' conclusions .... Where there is a quantifiable impact, the matrix could refer the reader to the appropriate chapter in the text."

Because there was no attempt to reorganize the EIS into a usable format, please consider the following remarks as criticism:

a. The EIS is neither outstandingly good nor bad. That is, it appears to represent the "state of the art" for documents of this type.

b. The EIS covers the points required by its format; i.e., it addresses the topics listed in its own outline. However, it does so with rather uneven emphasis resulting in inadequate attention to certain items of concern.

c. The document is unwieldy, repetitive, speculative, and vague; however, it must be acknowledged that such deficiencies are, in part, inherent in its format. Indexing and careful editing would be helpful in producing a more useful document.

3. Assignment of Priorities

The EIS does little to clarify the questions surrounding the assignment of fundamental priorities involved in the exploration and development of the Mid-Atlantic Shelf such as "national interest" conflicts between energy needs, environmental protection, shipping, military uses, fishing and other such matters. Therefore, it simply attempts to further an originally vaguely defined concept; no policy exists.

4. Validity of Data and Conclusions

It is obvious that not enough is known about the physical and biological environment of the OCS to know the magnitude of impact resulting from oil spills. Why is this basic information then included in the main body of the report, implying that some facts are being presented? In line with this basic question, please consider the following criticisms:

a. The geologic sections of the EIS are compounded of secondary and tertiary source information resulting in only a very elementary treatment of the geology of the region.

b. The report suffers from a lack of geologic information which does, in fact, exist, but which is difficult to access because of proprietary data restrictions and the poor timing of related investigations (e.g., baseline, benchmark, and environmental studies). For the same reasons, independent assessments and verifications of the data presented are seriously impeded.

c. Since the EIS acknowledges that predicting oil spill trajectories is guesswork (oceanographic intuition) at best, how can so much weight be placed on an analysis of the trajectories of hypothetical spills?

d. Since we cannot be certain where facilities are to be located and therefore what type and magnitude of impacts will be generated and felt, the majority of the discussion of impacts is meaningless.

e. Most of the calculations are based upon an assumption of oil discovery and production which is unrealistic by U.S.G.S. estimates. Using high estimates tends to overstate the potential market value and, hence, the rate of development of these resources.

f. The EIS fails to reach conclusions. The document could be used to support almost any action.

5. Basic Errors

A principal assumption of the EIS involves the replacement of imported crude by Atlantic oil (if any) at existing refineries. Acknowledging that the quality and type of oil that might be produced is unknown, the report fails to examine adequately the probability that major adjustments in refinery operations and equipment would be required to handle crude differing from that presently being refined.

Please consider the following analysis as elaboration of this point:

a. Petroleum Refining:

We have serious disagreement with the manner in which BLM discusses potential refinery impacts. Basically, in its impact projections, BLM does not include refineries as facilities necessitated or stimulated by the proposed sale, for the following stated reasons:

-Any OCS oil that might be produced in the Baltimore Canyon as a result of this sale could be expected to replace a share of oil imported into the region.

-New refinery capacity in the area would be built in response to increased consumer demand rather than to any new crude oil sources resulting from Baltimore Canyon OCS development.

This stance is similar to the assumptions presented in the Woodward-Clyde report.

Significantly, BLM does mention the possibility of additional refineries induced by OCS development, and discusses in general terms, possible impacts from a 200,000 barrel per day grassroots refinery. However, BLM does not report the results of any runs of its economic model based on assumptions of OCS induced grassroots or expanded refineries. This is somewhat inconsistent, considering BLM's mention elsewhere in the DEIS of its intentions to undertake a comprehensive refinery location study; furthermore, our original understanding was that this important study would be completed prior to BLM's DEIS publication.

Several important points raised in BLM's DEIS and Technical Paper #1 are worth comment:

-"Decisions to build new refineries are highly complex. They include consideration of demand, market location, supply of crude, availability and cost of capital, time for amortization, cost of crude, price of product, site availability, state and local receptivity to refinery development, and air and water quality standards. These factors are affected by National concerns." Page 57, technical paper, underlining is by RPA.

We agree with these comments, which contradict earlier BLM statements. The siting of refineries is highly complex and the guaranteed supply of crude is one of the most important siting factors. The Mid-Atlantic, with only 1.5 million barrels per day refining capacity and potential demand for refinery products of four times this capacity by year 2000, is an extremely attractive area for refinery development on economic (demand) grounds. In fact, several refineries have previously been proposed for the area. Supply and environmental uncertainties have been the major deterrents to additional refining capacity.

Should the lease sale result in new crude supplies of up to 740,000 barrels per day, there will be extensive pressure for additional refinery capacity in the Mid-Atlantic. We believe it is far more likely that crude imports from PAD III will be reduced, than it is for Mid-Atlantic crude imports to be reduced. As a result, a greater proportion of Mid-Atlantic refined products should be supplied regionally.

-"Alternatives to the option of building a new refinery include replacement of foreign crude with OCS oil, greater utilization of existing refining capacity, and the expansion of existing refinery capacity ... Arthur D. Little, Inc., in Potential Onshore Effects of Deepwater Oil Terminal - Related Industrial Development, has estimated that existing refinery capacity in the Mid-Atlantic could be expanded to 2.3 million barrels per day on site, that is with no new refineries."

Page 181, Draft EIS.

We think it is important to distinguish between new grassroots refineries and expansion of existing refineries. Despite the statements cited above, BLM does not appear to have considered any refinery expansion or grassroots refineries in its economic model. Certainly, the economic and environmental impacts of a 50 percent increase in existing refineries should have been considered in the model.

Furthermore, if proper siting is carried out and environmental concerns are addressed, we believe there is a reasonable probability that a new grassroots refinery of 200,000 barrels per day would be built as a result of OCS development and other siting factors.

In its final Draft EIS, to answer possible public concerns, we believe it would be valuable for BLM to show the impacts that refinery expansion and new refinery construction would have. This should be easy to do with BLM's economic model.

b. Petrochemicals:

BLM treats the petrochemicals industry as a secondary industry. Since BLM does not consider new refinery activity directly, the level of petrochemical industry induced is minimal and probably underestimated. Its analysis also lacks discussion of new petrochemical plants' potential use of natural gas as well as petroleum-based feedstocks. Furthermore, its statement that "expansion of existing refineries could result in the expansion of petrochemical activity ..." (page 203, EIS) is inconsistent with other statements discussing refinery and petrochemical activity.

Finally, BLM states (pages 221-222) that "... while the influx of gas processing in the Mid-Atlantic region may lead to very minimal increases in petrochemical activities in the region, increases are expected in existing areas of petrochemical activity; as a consequence, it is not anticipated that gas processing will lead to development of associated petrochemical plants." This conclusion is a direct result of the BLM model's structure, treating petrochemical activity endogenously instead of proper treatment as an exogenous variable.

6. Mitigating Measures

a. The continued reference to 30 CFR 250.34 (Development Plans) will remain a meaningless notation until we know: what constitutes an "affected state"; will there be an EIS on Development Plans; will the states have access to proprietary information; how will the affected states' comments be evaluated by the Supervisor and worked into the decision to approve or disapprove a Development Plan?

b. How will the Area Oil and Gas Supervisor be accountable to the states for his decisions?

c. The sale alternatives should be presented in a more expanded form and be developed into workable alternatives.

d. Why is it assumed that the tax revenues that are generated by OCS activity will compensate the states and local units of government for development expenses incurred while upgrading the public facilities?

SPECIFIC REMARKS

VOLUME I

1. pages 10-13: Section implies that states participated in tract selection. Role should not be characterized as more than that of observers. Many factors listed as criteria for selection not discussed at observed meetings. Fails to list "administrative decisions" as factor in tract selection.

2. pages 15-16: Note possible use of tankers. Report elsewhere acknowledges tankers as main sources of oil spills. Use of tankers should be avoided or covered by tight stipulations.

3. page 19: "Overriding factor" stated to be to obtain oil and gas from OCS. This conflicts with arbitrary designation and deletion of lease areas and, possibly, with OCS Lands Act.

4. page 22, Figure I-3): Lease schedules should be updated to reflect recent delays.

5. page 30, Figure I-4: Is coastal zone shown compatible

with State and other usage of this term?

6. page 34: Statement concerning federal grants to MAGCRC should be corrected.

7. page 49: The Continental Shelf as a geomorphic form does not "dip." (Dip is a structural term)

8. page 50, Figure II-1: Source of geologic time chart should be cited. Reference is apparently outdated.

9. page 52: Source of reference for interpretation or geophysical data needed but not presented.

10. page 53: Tertiary section arbitrarily dismissed as nonprospective. This is an unsubstantiated judgment and some clues to the contrary are known.

11. page 55: Postulation of a "Cretaceous reef" is important to the geologic interpretations. Why was this given only preliminary examination? Who made this interpretation?

12. page 60: Reference for "shore retreat massif" should be cited.

13. page 62: Example of inadequate referencing. Footnote meaningless.

14. page 68, Figure II-10: Inadequate and inaccurate classification of coastal features of Delaware.

15. page 70, Figure II-11: Very poor geologic map. Geologic column in reverse order. Inaccurate and contains typos. An obvious manifestation of the low quality of the treatment of the geologic subject matter.

16. pages 73-75, Figure II-13: Value or meaning of the soils section? Relationship to Visual No. 3 unclear.

17. page 79: Useless footnote. Repeated referencing problems.

18. page 83: a. Inadequate treatment of Delaware hydrology. References other than Cushing et al. should be consulted.

b. East Coast is not in "middle of North American Continental Plate."

19. page 84: References to earthquakes entirely inadequate and out-of-date. Treatment of this hazard is superficial.

20. page 87: a. Foundation hazard is probably associated with liquefaction rather than "compaction." Emphasizes need to identify buried lagoonal sediments referred to casually on page 61.

b. Text states that "gravity structures are not now planned." Does this mean that jack-up rigs and production platforms are eliminated from consideration? This appears unlikely. If statement is incorrect there is no justification for failing to discuss the associated engineering problems.

21. page 88: a. Note that seeps of "marsh gas" have been reported onshore in the Mid-Atlantic area.

b. If no information exists on geopressures in the Mid-Atlantic how can the hazard potential of excessive pressure be judged at all?

c. Treatment of fixed structures contradicts page 87. The consequences of sediment movement at fixed structures is inadequately addressed.

22. page 89: The treatment of Texas Towers is still inadequate

and apparently prejudiced in favor of minimizing the hazard of sediment scour.

23. page 94: Authors do not appear to be aware of the development of the northeast Seismograph Network. How will such data be accommodated in the future as it does become available?

24. page 177, Figure II-82: Shoreline Sites on the National Register of Historic Places does not show the City of New Castle or the City of Lewes.

25. pages 506-548: What happened to the detailed socio-economic data compiled by the State Planning Office and submitted to BLM?

26. page 558: Note speculation about effect on state waters of cancellation of Sale 40.

VOLUME II

27. page 1: Note that projections of effects are based on sale of 60% of tracts offered. Basis for this assumption should be questioned in view of dependence of rest of volume on this projection. Also, Mid-Atlantic EIS cannot be allowed to ignore the example of Sale 35 offshore California in which only 24% of tracts offered were leased, otherwise analysis is unrealistic.

28. pages 18-26: a. In view of spill hazard associated with tankers, they should not be used except in case of emergency. Use of tankers where pipelines not "technically and/or

economically feasible" is not acceptable.

b. Lightering should be prohibited by rule or stipulation. Our previous comments on this subject have been ignored.

29. page 23: The EIS acknowledges the hazard of pipeline rupture but fails to draw the logical conclusion that burial to protect from anchors, fishing gear, and shifting sediments is necessary. "Technical and economic feasibility" are used in this area as an unacceptable catch phrase.

30. pages 35-37, Table III-12: Sediment scour is a natural phenomenom not restricted to storm conditions and should be treated in hazard assessment.

31. pages 53-54: The EIS states that oil spill trajectories cannot be adequately defined from the existing data base. The report speaks of "lack of sufficient data," use of "oceanographic intuition," and "extreme lack of reliable data." We agree that this remains a major problem; therefore, no conclusions should be drawn in the EIS about the fate of oil spills.

32. pages 64-65: Note that (even) the new Coast Guard/OTA study of oil spills is expected to have serious deficiencies.

33. page 66: Note the admission that no present model of oil spill trajectories is predictive. Also, reliance on the Coast Guard is uncomfortable.

34. page 111: The effect of sediment scour should not be

ignored. Also, if shallow pockets of methane are recognized as hazards, what is the source of such gas? Possibly this is related to buried lagoonal sediments which may also be physically unstable.

35. pages 113-114: Geologic hazards are mentioned but not analyzed sufficiently. It remains unclear how such hazards will be treated in regulation or stipulation. Comments on Texas Towers, above, apply.

36. pages 131-133: References to tankers. See comment regarding pages 18.26.

37. pages 150-151: Priorities of use between conflicting interests need to be clarified before leases are granted on the Atlantic.

38. pages 151-152: Reported arsenic dump site off Maryland not discussed.

39. page 162: Number of wells drilled per rig used in estimates come from the Gulf operators. Why was this high estimate on wells drilled per rig per year given for the more hostile environment of the Mid-Atlantic?

40. pages 164-252: a. Report fails to quantify requirements for construction materials resulting from proposed action.

b. Onshore impacts on water supplies, a major Delaware concern, are ignored by the EIS.

41. page 169: Does the assumed refinery capacity include the Philadelphia refineries which were recently destroyed?

42. pages 176-177: Where will all of the required drilling equipment come from if all frontier areas are productive?

43. page 229: Is a strain placed on the use of Delaware beaches when recreation areas are removed in New Jersey (or vice versa)? Should these secondary impacts be included in the same way secondary employment opportunities are used as support of your proposal?

44. page 231: What is the magnitude of localized pollution generated by drilling operations (in PPM)?

45. page 266: What numbers of each species could be lost during a major accident?

46. page 303: What is the margin of safety in locating floating nuclear power plants near the sale area? If there is a conflict, which activity takes precedence?

47. page 312: Please detail the decision-making process involved when the Department of the Interior objectives come in conflict with those of the Department of Defense (Army, Navy, etc.).

48. pages 323, 334-343: Our concern about the adequacy of a Coast Guard contingency plan dealing with spills has been expressed elsewhere.

49. pages 347-348: In view of the major changes made in accommodating apparent military and NASA conflicts with the proposed lease areas since the tract selection meetings, the bases for resolution of such conflicts should be included in the EIS.

50. page 357: Note that proposed stipulations were developed by federal agencies only; no state participation.

51. page 361: a. Technical and economic feasibility qualifications should be deleted from tanker considerations.

b. The Oil and Gas Supervisor appears to have too much authority over transportation matters.

52. page 366: In view of the dependency of the EIS on "preliminary" analyses of high resolution seismic data, the exact status of such efforts should be specified. We suspect that the value of such data is overrated.

53. page 403, Figure VIII-1: Figure is incomplete and misleading. Nominated areas, some of highest interest, have been omitted.

54. page 426: Misleading statement which minimizes importance of mid-continent and Appalachian coal.

55. pages 551-598, Appendix 4: Description of drilling equipment and procedures are oversimplified.

VOLUME III

56. All visuals: a. visuals are oversimplified and no verification of content is possible due to omission of references and documentation. Useless for technical analysis.

b. Visuals contain graphic errors (such as airport, not seaplane base, in Rehoboth Bay that indicate their inadequacy.

c. The Delaware-New Jersey boundary is incorrectly represented in the Delaware River.

Visual Number 1: Recreation and Open Space Resources Potential Hazards: a. the "arsenic dump" needs explanation (196 tracts covered!); b. Shipwrecks should be plotted as hazards and indicators of dangerous areas; c. The nature of undetonated explosives and protective measures to be applied in prime lease areas should be specified; d. The Visual indicates that the City of Lewes, the land area around Rehoboth, Indian River and Sinapuxant Bays, and Fenwick Island are potential recreation and open space areas. The illustration is inconsistent because Rehoboth Beach and the Bethany areas are excluded. Either they are all in or all out of that designation.

Visual Number 2: Surface Wind Roses, Continental Shelf and Slope Water Circulation: No comment other than if a spill occurs it appears highly likely that the heavy PHC's will eventually reach Delaware Bay via bottom currents. This point was not brought out as strongly in the text as it could have been.

Visual Number 3: Soil Limitations for Foundations and Shallow Excavations, Bottom Sediments, Geological Features:

a. The Visual does not label any urban areas on the Delmarva Peninsula; b. The soil limitations are also inaccurate in Delaware, particularly Kent County and New Castle County; c. The area around Bowers Beach and Slaughter Beach are identified as non-critical shoreline erosion areas.

Visual Number 4: Vegetation Coastal Zone and Offshore Fisheries: The marsh identified in south central Sussex County and Wicomico/Worchester Counties is really fresh water and better characterized as something other than marsh, perhaps swamp.

Visual Number 5: Population Density, Petroleum Related

Facilities, Transportation Networks: a. Dover Air Force Base is excluded and there is no heliport in Delaware; b. The alignments of Route 13 and the railroads in Delaware are inaccurate.

MARVIN MANDEL
GOVERNOR

STATE OF MARYLAND
EXECUTIVE DEPARTMENT
ANNAPOLIS, MARYLAND 21404

February 16, 1976

Dear Frank:

I am enclosing a copy of the expanded comments regarding the draft EIS on Sale #40, prepared by our coastal zone management staff in the Department of Natural Resources. These may have been sent directly to your office, but I wanted to be sure as the time for comment is fast expiring.

Let me again commend your efforts as reflected in the improvements contained in the draft EIS.

If you have any questions, let me know.

Sincerely,

Simon F. McHugh, Jr.
Executive Assistant

Mr. Frank Basile
Bureau of Land Management
Atlantic OCS Office
6 World Trade Center
Suite 600D
New York, New York 10048

STATE OF MARYLAND
COMMENTS ON DRAFT ENVIRONMENTAL STATEMENT ON OCS SALE #40: THE BALTIMORE CANYON LEASE SALE

The Department of the Interior seeks to lease for oil and gas exploration, development and production 876, 750 acres of submarine lands 50-100 miles offshore the midatlantic coast in waters 30-170 meters deep. This represents nearly 10% of all the OCS lands that have been leased by the federal government and explored by the industry to date. Exploratory drilling to locate new oil and gas resources could begin within one year as a direct result of this leasing action. If resources are found in commercial quantities, then a development program could commence within 3 years. The first drop of new oil would not reach shore until at least 1981. According to the EIS, production of oil and gas, if it occurs, would peak about 1990, and would require as much as 600 acres of land onshore somewhere in the midatlantic region on which facilities supporting the offshore activity would be located. The Draft Environmental Statement on OCS Sale #40, The "Baltimore Canyon Sale," has been prepared by the Bureau of Land Management pursuant to the National Environmental Policy Act as a prerequisite to the Department of Interior's leasing action.

Despite a variety of shortcomings, the EIS presents a comprehensive review of the environmental impact caused by the introduction of offshore oil and gas activities into a frontier region (an area where to date those activities have never occurred). Maryland believes that the workmanlike quality of the product that has been produced is due in no small part to the substantial effort that BLM has made to seek the advice of experts in the region and to consult and coordinate with a wide array of parties and interests in order to ensure that the many concerns that should be examined have been addressed in the EIS. During the preparation of the EIS Maryland maintained frequent contact with BLM staff, and met formally with BLM six times. It is our hope that such contact will prove more the rule than the exception as the Department of Interior embarks on at least a generation of resource management in the middle atlantic region. It is fair to warn, however, that contact alone does not assure recognition of state concerns. If the EIS suffers from a single pervasive failing it is that shallow lip service has been paid to concerns felt deeply by coastal communities. Assumptions on which the analysis is based have been chosen to circumscribe hard choices which must be made. The EIS will not be fully satisfactory until it wades into the surf of the hard decisions and emerges with descriptions of the hard choices that are faced by the public, and all levels of government.

SECTION II - "Description of the Environment"

The most severe constraint on the usefulness of the "Description of the Environment" section of the EIS is the paucity of reliable scientific data on the midatlantic marine and coastal environment that is available. It is ironic that coincident with preparing the EIS, the BLM also designed and contracted for a massive environmental assessment of the midatlantic marine environment. The final environmental statement could benefit from cross-fertilization between these projects. At the very least, data gaps in the "Description of the Environment" that will be filled by the environmental assessment effort should be identified as they are encountered. Such indexing could foster better understanding of the BLM's environmental program.

Another pervasive weakness of the "Description of the Environment" Section is its sketchy treatment of the Chesapeake Bay ecosystem and cultural environment. For example the "physical oceanography" subsection makes no reference to Chesapeake Bay in its treatment of drowned river mouths, nor is any discussion included in the "Biological Communities" subsection of Chesapeake Bay's phytoplankton or zooplankton communities. The rationale for treating Delaware and Raritan Bays much more extensively is that the Chesapeake Region is located at sizeable distances from the sale, and is protected from offshore pollution by "general oceanographic parameters". To the contrary, Maryland's review indicates, and isolated portions of the EIS concur, that:

1. During the spring season there is a possibility that a major spill incident on the OCS could reach shore. Such an occurrence could coat the beaches with thick crude oil for miles anywhere from Cape Charles to Sandy Hook, just weeks before the onset of the intensive summer recreation season. Spring season surface currents could also carry the unweathered oil into the Chesapeake Bay. Although we concur with the finding that the environmental catastrophe from such an event would be dulled over time, as happened during the second world war when crude oil coated the coast, the fiscal and recreational damages resulting from the obliteration of the summer tourist season, and concurrent fisheries contamination, are not calculable.
2. The prevailing bottom current drift in the midatlantic could carry incidental OCS pollution into Chesapeake Bay throughout the year.
3. Large populations of birds and fish migrate annually through the offshore region, including the lease tracts, to winter, summer,

or spawn in Chesapeake Bay. This direct interaction between the leasing area and the Chesapeake Bay occurs at a random but significant pace throughout the year. Activities in one area can have a direct, measurable, and significant effect on the other. For example, contamination of striped bass in the offshore area could impact on recreational fisheries in Chesapeake Bay.

4. Chesapeake Bay is this country's largest enclosed embayment and estuary and it is a singular ecological resource. Furthermore, because its location is central to both the middle atlantic and south atlantic frontier areas, Chesapeake Bay is a likely site for rig construction or other land consumptive, water-oriented OCS related facilities. In fact, plans are now proceeding for a 1500 acre OCS rig fabrication facility at Cape Charles, Virginia and land speculation has begun near Crisfield in Somerset County, Maryland. The Bethlehem Steel Corporation's plant at Sparrow's Point in Baltimore Harbor has, in the past, constructed OCS drilling equipment and it is quite possible that it will contract to do so in the future.

In light of these facts, the final environmental statement should treat all middle atlantic estuaries in similar levels of detail.

SECTION III - "Environmental Impacts of the Proposed Action"

Section III D.1.b. concludes that although the economic impact from OCS activities on the mid atlantic region may be minimal, the possible impact on single coastal community could well be significant. The EIS then includes a series of short paragraphs summarizing possible economic impacts on three economically different localities. Finally, in summary on this point, the EIS notes that "For a given locality, particularly the least developed, the investment that could result from the proposed action could represent a heavy shock to its economy ..." Such a stern warning deserves more extensive discussion than is present in the EIS. Although the siting and operation of the facilities that generate the economic impact are subject to state and local regulation, the need for the facilities will be directly stimulated by the federal activities discussed in this EIS. For this reason, possible economic impacts at the community level deserve as extensive treatment as is given to discussion of the less meaningful topic of "regional impact", which is exhaustively pursued throughout this section of the EIS.

Rural counties and municipalities are particularly prone to suffer adverse effects from improperly planned capital investment. A relatively small construction project can induce "boom/bust" effects. Provision of a new sanitary sewerage system, prerequisite to any kind of intensive development, can send a government into bankruptcy if it cannot be amortized through taxes. This scenario could easily be realized if proposed or expected OCS-generated developments fail to occur.

A useful discussion of community level economic impact would include an extensive discussion of the boom-bust cycle associated with construction of facilities; an expanded case study discussion of community level impact that would illustrate how sensitive the impacts will be to the timing, location, nature, and level of investments contemplated; and substantial analysis of possible activities and (negative) impacts that will occur after the 25 year life of the field. A parallel discussion in the "Mitigating Measures" section should identify and discuss possible revenue and financing strategies that localities and the federal government could pursue to alleviate possible economic burdens.

To facilitate the determination of environmental impact, natural gas production, shipment and processing should be discussed separately from oil. The introduction of "new" gas supplies in the middle atlantic region, with its attendant separate supply and demand structure, relative ease of processing, and unique price regulation procedures, presents benefits and costs that should be treated separately from oil to provide a more accurate display of benefits and costs of the proposed action.

Section 3 also should establish critical production levels at which new processing facilities will be required. Although Maryland accepts, for the purposes of the Statement, the BLM's assumption that no new refineries will be generated by this sale, a more objective approach to the question of need for new facilities would be to calculate production threshold levels, or ranges of production, at which new facilities could be stimulated in the middle atlantic region. The BLM will not be extending full consideration to the environmental impact of the proposed action until it recognizes that this action raises at least the possibility that new processing capacity will be built in the mid-atlantic as a result of this sale.

The demand induced logic underlying the "No new refineries" assumption is not entirely acceptable because OCS oil could substitute more easily perhaps for the import of expensive domestic (Gulf) refined products into the mid atlantic region than it could substitute for foreign crude product. This is evidenced by the fact, that there is currently a proposal by the Crown Petroleum Corporation to build a 200,000 barrel grass-roots refinery in Baltimore City, and the Steuart Petroleum Corporation has in the recent past sought to build a refinery in St. Mary's County, Maryland at the mouth of the Potomac River.

BLM should, at a minimum, define refinery capacity, inventory available refinery capacity and possibilities for expansion, and establishing production threshold levels for new facilities, as discussed above.

Section III also does not give a full treatment to the factors governing choice of harbors and harbor activities, particularly inter-harbor competition Evaluation of harbor activities is a highly complex process incorporating geographic, economic, and operations research techniques. This impact statement though, shows little evidence of making more than an intuitive estimation of the roles various Eastern Seaboard ports will play in OCS generated development. It is quite possible that OCS-generated harbor activities will concentrate at the Port of New York/New Jersey and Delaware Bay, but it is felt that more analysis of intra-regional hydrocarbon demands, national transportation networks, existing port infra-structure, and proposed expansions including channel deepening must be made to support this conclusion. In addition, more information should be provided in this impact statement on the interrelationships among Middle-Atlantic ports, particularly how a decision at one port affects others within the region. Expansion of facilities at New York/New Jersey will be felt in some way by the Port of Baltimore through a reallocation of business. Further, the effects of potential harbor improvements such as contanerization, channel deepening, or expanded pierage on the regional network should be assessed.

Finally, Section 3 should respond to estimates of environmental impact made by other investigators, by explaining how varying estimates have been arrived at, and why they differ. For example, the EIS concludes that a population increase of 20,000 could occur with a resource find of 740,000 BBL/day, while Goodman, in "Decisions for Delaware" estimates a 60,000 person population increase if production reaches 1,000,000 BBL/day. Other investigators' conclusions about environmental impact should at least be addressed in the EIS.

SECTION IV - "Mitigating Measures"

Periodic inspection, and operational vigilance, are the key to safe and environmentally clean operations on the continental shelf. Through its inspections, and "Potential Incidents of Noncompliance (PINC)" checklist the Geological Survey exercises adequate control over those OCS operations which are directly under its purview. However, the Geological Survey's jurisdiction does not extend to all operations on the continental shelf.

No pipelines on the continental shelf other than gathering lines, are subject to a regular, rigorous inspection and monitoring program similar to the Geological Survey's PINC inspection program. Currently, inspections, if they can be called such, do not occur unless a support pilot happens to fly the general route of a pipeline out to a platform, and chances to notice an oil sheen on the surface. By then, of course, a pollution incident has occurred. Perhaps this glaring regulatory gap helps to explain why 34% of all OCS spills, and 67% of all oil spilled from OCS operations, results from incidents associated with pipelines. Pipeline safety is an especially critical issue in the mid-atlantic because geological conditions appear to foster substantial sand movement and sediment scour, which can undermine the structural integrity of pipelines.

As manager of the OCS lands, the BLM must ensure to the satisfaction of the coastal states and the nation, that responsibilities for pipeline inspection and monitoring are firmly delegated, and safety and inspection programs designed, before sale number 40 takes place. Such a program would be as rigorous and regular as the Geological Survey's PINC program. The regulatory program must be designed, and authorities delegated, before the lease sale because the nature of the program will influence the bids and operations of the potential lessees.

The EIS proposes seven lease stipulations for the protection of particular resources and activities. Three more stipulations should be included to: minimize an additional environmental risk resulting from conducting operations in adverse weather conditions; provide the Secretary with the authority to revoke a Lease in the event of a calamity, while "making the Lessee whole",and to require that the Lessee will be held strictly liable for direct and indirect damages arising from OCS pollution incidents.

Spill containment devices cannot function in all weather states. The EIS estimates that containment devices will "approach their least favorable operating conditions between ...10% and 30% ... of the year." Critical drilling and development operations conducted during those substantial periods when spill containment would not be at all possible could pose substantially greater risk to the environment than is explicitly recognized in the EIS. Although the Secretary of the Department of the Interior retains the general authority to suspend OCS operations for conservation purposes, and Industry may, if it desires, curtail operations in bad weather, a special stipulation should be included for all tracts which would give the area supervisor the explicit authority to suspend all operations, or certain critical operations, when weather and sea state conditions exceed the bounds of effective spill containment operations. Suggested language follows:

> "When the supervisor has reason to believe that due to meteorological, sea state, or other natural conditions, it would be temporarily impossible to carry out effective spill containment operations on the continental shelf, then the supervisor may order the suspension of certain operations which bear a heightened risk of an oil spill until climatic conditions improve."

The Outer Continental Shelf Lands Act, 43 U.S.C. S.1334(a)(1), authorizes the Secretary of the Interior to prescribe whatever regulations are necessary to prevent waste, and to conserve OCS natural resource. Conformance with the national environmental policy as stated in NEPA, 42 U.S.C. S.4332, requires the Secretary to retain the authority to cancel an OCS lease in the event of extreme environmental threat or catastrophe. Henceforth, the following stipulation should be added to every OCS lease:

> "The Secretary may cancel any lease at any time, when continued activity pursuant to such lease would threaten serious or irreparable harm or damage to life, (including aquatic life), to property, to any mineral deposits, to the national security or defense, or to the marine, coastal or human environment. In compensation for this action the Secretary may return to the lessees all or a portion of the bonuses and royalties that have been paid by the lessee".

In support of this departure from present practice, we note that oil and gas leases for midatlantic tracts will vest property rights in the purchasers only according to the terms of the leases subject to these regulations which are effective at the time of the sale.

Despite current legislative initiatives to indemnify the oil industry and property owners in the event of oil pollution, OCS lessees must be held strictly liable for direct and indirect damages resulting from OCS pollution. No other policy can do as much to ensure that industry operations are conducted in a safe, clean and cautious manner. The following stipulation should be included on each midatlantic lease:

> "The lessee will be strictly liable for direct and indirect costs or damages due to spills or any other pollution incidents resulting from OCS operations".

The language of the pipeline burial stipulation needs tightening to ensure that all OCS pipelines are buried wherever and whenever feasible. The first sentence should be amended as follows, "Except where conclusively demonstrated facts are presented that burial of pipelines is technically and economically infeasible, all pipelines, ..."

The discussion of pipeline corridor management studies (v.2, p.356) indicates that "Representatives of affected states as well as the petroleum industry will be encouraged to participate in this planning effort." Maryland would like to underscore the importance of such participation to ensure that management studies and practices meet the concerns of all interested parties.

In addition to "encouraging participation", the BLM should seek to obtain mutual state-federal agreement to the location of pipeline corridors, and particularly landfall locations, for only through negotiated agreement will all parties find satisfaction in the result.

The advent of subsea production systems has created a need for a new OCS order to provide guidelines for their use. Because subsea systems are a new technology, a detailed Order should be issued before they are employed on the mid atlantic OCS.

SECTION VIII - "Alternatives to the Proposed Action"

The discussion of coal as an alternative contains several misleading inferences. Whereas it is true that, "Most of our coal is found West of the Mississippi River ..." (v.2, page 426), the fact remains that considerable quantities of coal remain in the Appalachians close to the middle atlantic states. It seems likely that the Appalachian coal would be a more viable substitute for OCS oil and gas than western coal as may be inferred from the quoted paragraph. Furthermore, we have not read any serious proposals concerning the transportation of Western coal to the Eastern states via slurry pipelines. The discussion of slurry pipelines (v.2, p. 429) appears to raise a false issue and should be eliminated. The section on surface mining of coal produces the impression that surface mining procedures produces permanent environmental effects. Yet, most coal mining states have passed comprehensive environmental legislation with respect to surface mining which minimizes the impact at the time of mining and requires restoration of the land.

The discussion of deletion or addition of tracts in the "Alternatives" section is of great interest to the State of Maryland. Specifically, the State ment that "all tracts or areas which received negative nominations on the basis of scientific fact or multiple-use limitations were omitted," requires explanation. During the tract selection process, tracts with high resource potential located South of a line drawn East from the Coast at approximately Rehoboth Beach, Delaware were deleted from this sale for "administrative reasons" associated with conflicts of use. Apparently, these use conflicts may cloud the leasing future of all OCS tracts located South of Rehoboth, Delaware. The leasing future of those tracts that are presently excluded, will bear directly on Maryland's state and local planning to accommodate the demands of offshore oil. Without knowing, the leasing future of OCS tracts located South of Rehoboth Beach, Delaware, Maryland cannot begin to understand the cumulative environmental impact of OCS activity. Such an understanding should be vital input into the tough long range policy and planning decisions which states face in the near future. The reasons and ramifications of Sale 40's tract selection decisions, and the relationships between the tract selections for Sale number 40 and future mid atlantic lease sales, should be explained in the final environmental statement. At a minimum, this EIS should provide a determination of the leasing future of those tracts that have been deleted from this sale. The official determination that those tracts may be leased in future sales, or will never be leased because of conflicts of use, will prove an important factor in state decisions on OCS activity.

The State of Maryland recognizes and appreciates the considerable time and effort that has been devoted to developing the "STATE PARTICIPATION" leasing alternative. The substance and process of this leasing option would maximize wise resource use, safeguard the return to the federal treasury, and promote coordination between all levels of government charged with protecting the environment and safeguarding the public interest. The concepts embodied in the discussion should be refined at several points:

1. Because of the wide variety of intensive uses of the mid atlantic coastal area, and the distinct possibility of unforeseen use conflicts in the future the Department of Interior must exercise explicit authority to terminate an OCS lease in order to comply with the National Environmental Policy Act. Any termination provision may necessitate reimbursing the lessee by returning any bonus or royalty monies that have been collected. Procedures to "make the lessee whole" would minimize the possible adverse effect that termination provisions could have on industry participation in lease sales.

   Similar powers should be exercised to expand the guidelines under which suspensions and unitization schemes are approved to include compliance with NEPA. Recent litigation attempts underscore the urgent need for expansion and clarification of the "suspension" provisions of the OCS lands Act.

2. The duration of the time period to be provided for state review and comment remains undecided. Although a maximum period of six months should be provided in order to be consistent with the Coastal Zone Management Act, this provision should be structured to minimize delay. One means of accomplishing this would be to provide a 90 day review period with a 90 day extension if requested by any party.

3. The State of Maryland opposes unitization of exploratory operations (v.2 p. 472) because it would slow the pace of discovery while also reducing overall innovative discovery effort.

4. Appendix I consists of a list of information which sould be included in the expanded development plan submitted for state review.

The State of Maryland urges adoption of this leasing alternative for sale number 40. In doing so, the Department of Interior will lay the foundation for a generation of state, federal, and local government cooperation and coordination in exploring for, developing, and producing continental shelf resources in the middle atlantic region.

APPENDIX I

Resource Characterization

1) With text and detailed maps, locate and describe the proposed development area with respect to:

   a) Geographical features

   b) Existing onshore and offshore facilities, including other oil and gas developments nearby;

   c) The nature and extent of all known oil and gas resources and reserves, leases and other oil and gas activity in the immediate region.

2) Provide particulars on the resource to be developed, including at least, type, sulfur content, specific gravity.

3) Provide particulars on the reservoir(s) to be exploited, including depth of reservoir, volume, type of rock, pore pressure, faults, fissures, and features constituting risks.

4) What is the estimated total volume of resources? Anticipated depletion rate? Life of the field?

5) How many wells will be drilled on the tract? Where will they be placed? How deep? Is this development activity part of a unitization plan?

6) Provide any geophysical or geological records that were collected as a result of detailed site surveys for archaelogical or other purposes.

Processing Stream and Operations

Describe anticipated and proposed processing, including transport, of the resource(s) from the reservoir to the end use as a wholesale product on land. Indicate at each pertinent point in the processing stream:

1) facilities needed

2) purpose and nature of operations

3) potential sources of chronic and catastrophic environmental impacts, including noise, visual, air and water pollution, and other environmental impacts.

Facilities Requirements

Show on detailed maps the anticipated location of all production units, permanent structures or platforms, on shore and offshore suport facilities, rights-of-way and pipelines, and other infrastructure necessary to produce transport, process and distribute oil and gas from the lease area. Summarize and detail requirements for the following facilities and services. Explain how your requirements will be met.

1) Any pipeline designed to carry, or capable of carrying, crude oil or natural gas ashore from offshore sources;

2) Any production facilities, including refinery which is designed to process at least ten thousand barrels of crude oil equivalent per calendar day.

Included under this subsection are:

a) Production facilities designed to perform one or more of the following functions:

   1. Separate natural gas from an oil/water mixture;

   2. Dehydrate and/or pressurize natural gas prior to its entering or reentering a pipeline;

   3. Pressurize an oil/water mixture prior to its entering or reentering a pipeline.

b) Intermediate production terminals designed to perform one or more of the following functions:

   1. Separate an oil/water mixture;

   2. Separate sand from an oil or oil/water mixture.

c) Natural gas processing facilities designed to perform one or more of the following functions:

   1. Dehydrate and/or pressurize natural gas;

   2. Extract and treat heavy fractions of natural gas such as butane and propane;

   3. Repressurize natural gas for pipeline transmission.

d) Handling facilities and receiving, shipping or transhipment terminals designed to handle, or capable of handling, crude oil and having an average throughput at least 10,000 barrels per calendar day.

e) Refineries.

BEST COPY AVAILABLE

3) Any oil storage facility designed to handle, or capable of handling, crude oil.

    a) Whose total design capacity is at least 100,000 barrels; or

    b) Which occupies at least 50 acres; or

    c) Whose average throughput is at least 10,000 barrels per calendar day;

4) Any operations base which:

    a) Includes port and harbor facilities, and

    b) Occupies at least 25 acres, and

    c) Is designed, constructed and operated as an assembly area for the storage, handling, and transport of supplies whose next and final destination is any oil and/or gas exploration, development, or production-related operation conducted in the territorial sea, contiguous zone or high seas area; or

5) Any fabrication yard which is an assembly operation used for the construction or preparation of petroleum drilling rigs, jackets or platforms, or wellhead installations, whose final destination is installation or operation in the territorial sea, contiguous zone, or high seas area.

6) rigs

7) platforms

8) supply vessels

9) crew ships

10) tugs

11) standby vessels

12) navigation services

13) marine supplies and repairs

14) tank barges

15) drilling tools and services

16) cement supplies

17) welding

18) well casings

19) wellhead equipment
20) anti-corrosion services
21) core analysis and well testing
22) machine supply, rental
23) machine repair
24) oceanographic instruments
25) divers and diving services
26) diving equipment
27) helicopters
28) float planes
29) trucking
30) rail service
31) shipping agents
32) freight handling
33) warehousing
34) drilling crews
35) drilling muds and chemicals
36) weather forecasting services
37) non-destructive testing services
38) safety and firefighting equipment
39) medical facilities
40) engineering services
41) contract maintenance
42) inspection services
43) pipe yards
44) pipelaying services
45) welding

46) seismic surveys services

47) catering

48) accomodation leasing

49) property agents

50) communication services

51) radio equipment

52) bunkering facilities for oil & freshwater supply

53) pollution control

54) office space for oil and geophysical firms, etc.

55) technical training facilities

Facility Review

For each facility construction or expansion project identified above, supply as much of the following information as is possible at this time:

1) Physical requirements for the facility (service):

   a) Identify and describe the type of facility envisioned;

   b) List and explain the criteria used in the selection of sites;

   c) State the gross amount of land required.

   d) Provide a general description of sites favored for the facility. Locate alternative sites on a map and indicate preferences, and the reasons for same.

   e) Describe the type of water access required for any facility.

   f) For pipelines and transport services prepare a map indicating the route to be followed and the water crossings to be made.

   g) State the projected capital cost of the facility.

   h) State the construction period of the facility, with construction commencement and termination dates.

2) Describe what the facility will do, and how it will operate.

3) What is the status of land acquisition for the facility? What is the status of zoning?

4) Summarize the potential environmental and economic impact of the facility.

   a) Identify and discuss potential sources of impacts, including noise, visual, air and water pollution, and other environmental impacts.

   b) Explain how the following requirements will be met:

      1. Electricity and other energy demand

      2. Surface and/or groundwater

      3. Shoreline access

      4. Municipal facility interconnections

   c) What will be the impact of the facility on the community in which it locates:

      1. Identify the employment (and income)

         a. construction

         b. operation

      of the facility.

      2. What materials will be handled?

      3. Describe operating procedures

      4. Provide traffic estimates for port, highway, and rail transport.

Other Information

1) Inventory unusual conditions on or offshore requiring special precautions to protect the environment or to insure safe operations. Describe measures which will be taken to ameliorate these unusual conditions.

2) Inventory other uses of the lease and right-of-way locations, including endangered species habitat, fishing grounds, recreational activities, or other uses which may require special treatment or precautions to ensure safe and environmentally sound development.

3) Contingency plans for oil spill clean-up.

4) Such other information as may be requested by the Governor to determine environmental or economic impacts of the proposed development.

APPENDIX II

Other Comments:

Volume I, p. 86: We believe that the language referring to special engineering studies should be more positive than "... they may require..." We suggest substituting the language "... they will require ..."

Volume I, p. 299: The "Assateague Study" conducted by the Natural Resources Institute should be included as a reference in this section. Furthermore, the Smithsonian Institute's "Natural Areas of Chesapeake Bay" includes a rare and endangered plant species list which should also be referenced in the EIS.

Volume II, p. 100, impacts upon flora: No mention is made of potential damages to beds of Sostera marina, the rooted aquatic plant eelgrass, nor of the communities associated with it.

Volume II, p. 106: water soluble aromatics not removed from formation waters ... If there are water soluble toxins which are present in water shipped to shore, the volume, components, and shoreside treatment and disposal become important. Volume II, p. 19 suggests that the average oil content of discharged effluents will be limited to 48 mg/1. URS Research Co. (1973) reported, in an EIS for the proposed Seuart Refinery in St. Mary's Co., that discharges containing 32.-102.1 ppm "oil" caused contamination in a small salt creek. Dominance of blue green algae and Nereis sp. worms was reported, as was death of Spartina sp, Carcinus sp (crab) and Gobius sp (Fish). Mortalities reported derived from 7-25 mg/1 oil discharged into the creek. They also reported that biodegradation of refinery effluents did not remove chronic toxins.

Volume II, p. 77: season of susceptibility of larvae to oil spills: Change Morone saxatilis from "summer" to "spring".

Volume II, Appendix 9, p. 630: 450 mg/1 should read 450 micrograms per liter i.e., should be parts per billion.

Also, p. 633: copepods ingesting oil at the rate of 1.5 x 104 grams/day/individual = 15 kg/day. Must be an error in the exponent.

Volume II, Appendix 9, p. 664: citation of Tissier and Oudin: Seems to read that polluted sediments have a lower percentage of hydrocarbons with even-numbered carbon chain dominance. This appears to be at variance with a statement on p. 625 which reads "In organisms, alkanes of C_{60} and smaller are predominantly odd-numbered chains, while in petroleum odd and even numbered chains occur in a 1:1 ratio.

Volume II, p. 269: endangered species: does not mention the bog turtle, or the Maryland darter. It does not mention the blackbanded sunfish which is rare in Maryland, nor relict populations of Cottus bairdi and Noturus insignis on the Eastern Shore.

Volume II, p. 190-91 mentions the increasing demands on water, sewerage, retail industry, public administration. Volume I, p. 192-201 defines the areas of Maryland comprising the Eastern Shore, and the lower Potomac drainage as areas 18 and 20, respectively. Volume II, p. 274 notes that projected population increases are modeled to produced additional BOD loadings in area 18 to the extent of a 30% increase and in area 20 to the extant of a 100% increase. Nowhere does the DEIS discuss the aggravation of these effects because of the absence of front-end monies. The public administration and additional public facilities which such projections require will not be available without these monies, but their importance is not discussed by the draft, nor are any plans of the Federal government to alleviate these absences. In fact there are numerous references to the responsibilities of State programs and local zoning authority to avoid many of the hazards of rapid population increases.

Volume II, p. 241: DEIS suggests that non-spill related water quality impacts are expected to be minimal. This ignores the impacts of modifications brought about by land use changes related to the population buildup. No mention is made of the impacts generated by construction, maintenance and use of water and sewage facilities, transportation facilities, and urbanization in general. A figure attached to this comment illustrates the construction impacts, in terms of sedimentation, of laying a pipeline. These same impacts are caused by any heavy construction, and are severe when imposed on a small drainage basin/watercourse.

Volume III --The color maps are not useful for a variety of reasons. The scale is too small to present the data in a useful fashion. Several of the data displayed on the maps, especially for shellfish and wetlands vegetation do not agree with their sources. Hard and soft dam beds appear to have been switched. Wetlands are not represented accurately. The maps do not extend coverage over the entire Delmarva Peninsula.

COMMONWEALTH of VIRGINIA
Council on the Environment

GERALD P. McCARTHY
ADMINISTRATOR

903 NINTH STREET OFFICE BUILDING
RICHMOND 23219

February 24, 1976

Mr. Curtis J. Berklund, Director
Bureau of Land Management
U.S. Department of the Interior
Washington, D.C. 20240

Subject: Draft Environmental Impact Statement, Mid-Atlantic Outer Continental Shelf Oil and Gas Lease Sale #40

Dear Mr. Berklund:

We have completed our review of the subject document. The following state agencies participated in this review:

Division of State Planning and Community Affairs
State Water Control Board
State Department of Health
Commission of Game and Inland Fisheries
State Air Pollution Control Board
Commission of Outdoor Recreation
Virginia Department of Agriculture and Commerce
Virginia Port Authority
Virginia State Energy Office
Division of Industrial Development

Enclosed is a copy of the testimony prepared for the Department of Interior's Public Hearing on the subject in Atlantic City on January 27, 1976 (Appendix A). These comments provide our general evaluation of the Statement with respect to its analysis and conclusions regarding the environmental impact of the proposed oil and gas lease Sale #40. Several points made in that testimony deserve elaboration. We also have a number of more specific comments on both the substantive content of the Environmental Impact Statement and the adequacy of the Environmental Impact Statement document itself. Enclosed, therefore, is a supplement to our previously filed written testimony (Appendix B). The supplemental comments address the following topics:

I. Substantive Content of the Environmental Impact Statement

   A. Onshore Impacts in General

   B. Treatment of Effects on Agriculture

   C. Treatment of Estuaries

II. Adequacy of the Environmental Impact Statement Document

   A. Specific Comments

   B. Format

I would like to reiterate that, as far as the offshore area is concerned, the Statement is quite adequate and well-done within the limits of information currently available. Additionally, the Commonwealth of Virginia clearly recognizes the well-established need for development and utilization of U.S. petroleum resources. We are in agreement with the Department of Interior's determination that environmental and technical considerations, while requiring thorough and serious evaluation and planning, do not warrant delay in moving forward with the potential leasing of particular areas of promise.

Thank you for the opportunity to review the subject document. We hope the enclosed comments are useful and look forward to receiving the Department of Interior's response in the Final Environmental Impact Statement.

Sincerely,

Gerald P. McCarthy

GPM:dls

Enclosures - Two

cc: Mr. Frank Basile, Manager, New York OCS Office
Honorable Earl J. Shiflet, Secretary of Commerce and Resources
Dr. James Calver, Division of Mineral Resources
Mr. Keith Buttleman, Division of State Planning and Community Affairs
Mr. J. L. Hamrick, State Water Control Board

Mr. Oscar H. Adams, State Department of Health
Colonel George Dawes, Virginia Institute of Marine Science
Mr. E. Wilson, Virginia Energy Office
Mr. Frank Alspaugh, Division of Industrial Development
Mr. M. V. Craft, Virginia Port Authority
Dr. Berkwood Farmer, Department of Agriculture and Commerce
Mr. Paul Pitts, State Air Pollution Control Board
Mr. James F. McInteer, Commission of Game and Inland Fisheries
Mr. Rob R. Blackmore, Commission of Outdoor Recreation

Supplemental Comments
To the Testimony Dated January 27, 1976
Submitted by the Commonwealth of Virginia
Regarding
Proposed Mid-Atlantic Outer Continental Shelf Oil and Gas Lease Sale #40

I. Substantive Content of the Environmental Impact Statement

A. Onshore Impacts in General

We are quite concerned about the treatment of onshore impacts. If oil is found in exploitable quantities, it must come ashore someplace and be processed. The impacts onshore, both environmental and socio-economic, will not be distributed over the entire Mid-Atlantic area but will be localized in their effect. It is fruitless therefore to assess onshore impacts on an area basis alone. As an example, the impact of accompanying heavy industry may be minimal in the Delaware Bay region. On the other hand, the impact can be substantial if superimposed on Northampton County. This may very well be possible in light of the activities of Brown and Root, Incorporated, at Cape Charles. An influx of workers and families in Northampton could trigger a requirement for "front-end" funding to provide essential schools and municipal services. Similarly, if drilling rigs are to be constructed in Northampton County, their transportation to the area of operations can engender very serious impacts on the marine environment, both onshore and near-shore in the lower Chesapeake Bay region. In general, the cumulative impacts of several OCS Lease Sales, especially if those off the more southern areas are included in the analysis, could result in negative impacts beyond the control of local or state governments if those impacts are not adequately planned for and managed. Of particular importance is proper planning within Virginia localities to provide for potable water, wastewater treatment facilities, and solid waste disposal if onshore development is anticipated.

B. Treatment of Effects on Agriculture

The lack of sufficient information pertaining on on-shore supportive activities has created much uncertainty from the standpoint of our agricultural economy on the Eastern Shore.

The degree and time period of on-shore activity developments are unclear. Without additional information and improved quantitative estimates, an objective evaluation from the standpoint of agriculture can not be made at this time.

However, this report clearly demonstrates the following points:

1. If the on-shore support activities are minimal, significant reductions in agricultural output are not likely to occur. Even if the activities are rather large in nature, effective planning could direct the activities to marginal or less productive lands thereby lessening the impact on agricultural production.

2. More attention should be given to the long-run costs to society when agricultural lands are used for other than agricultural purposes. This study is typical of most studies of this nature in that the loss of agricultural lands is treated very mildly and almost exclusively in short-run terms.

3. There may be a possible conflict between ocean dumping of sludge and off-shore drilling activities. If so, the approval of drilling activities will add pressure to the future feasibility of land application of sludge.

With an increasing demand for petroleum products and some uncertainty in the supply, every possible effort must be attempted to obtain new supplies. At the same time, the Eastern Shore of Virginia is a productive agricultural area and irreversible agricultural losses should be minimized or avoided where possible.

C. Treatment of Estuaries

The statement is inadequate in its treatment of estuaries in general. The specific omission of Chesapeake Bay, apparently based on the assumption that only the Atlantic Coast will be impacted, is most serious. This point was called to the attention of the drafters in the preliminary draft statement. There are too many indicators that Chesapeake Bay will be impacted. These are, briefly, the recently arrived presence of Brown and Root in Northampton, the developmental plans of the Hampton Roads Energy Company, announced expansion plans of the Amoco Refinery in Yorktown, and efforts to expand facilities of Steuart Petroleum Company in the middle reaches of the Potomac River. The recent oil spill with a reported kill of 9000± waterfowl is indicative of potential impacts which should be addressed.

In omitting Chesapeake Bay, two other significant factors are ignored. First, the statement is concerned only with the Mid-Atlantic sales and does not relate to planned sales in the South Atlantic. Chesapeake Bay is a pivotal point between the two lease areas. Second, the statement fails to predict where foreign oil, now being imported, will be delivered if New Jersey refineries are fully supplied with OCS oil. It would be premature to forecast that OCS oil can replace all current foreign imports and, even so, predicted increases in energy consumption are ignored. Chesapeake Bay is all too likely to be the reception area for foreign imports.

The impact of oil spills on the wetlands and shallows of the Barrier Island complex is not treated. Efforts in the statement to forecast travel time of spills and the resultant weathering of oil are commendable. But, there has been no attention to the effects of a spill which might penetrate the barrier islands and lodge in the interior lagoon and marsh complex for an extended period of time. Again, the recent oil spill exemplifies potential impacts.

The present lack of jurisdiction over foreign vessels by the U.S. Coast Guard beyond the 12 mile limit and the problems this will create is not addressed. In view of the large foreign fishing fleets currently operating off-shore and the potential for many oil tankers under foreign registry in the drilling area, it is obvious that without U.S. Coast Guard legal controls of these vessels the chances of major oil spills with the resultant loss of life and property will be seriously enhanced. The fact that legislation is before Congress to extend the limit to 200 miles is recognized, however, it is felt that the Environmental Statement should document this problem as a possible adverse impact.

We are deeply concerned with the real and potential impacts on the environment in general and on shellfish in particular. Shellfish off the coast of the United States are a commercially valuable resource, not only for Virginia, but for most of the coastal states of this country. Scallops and surf clams in off-shore areas and oysters, soft-shell clams, and hard-shell clams in the near shore areas and estuaries support a multimillion dollar industry.

The most severe impact that OCS development could have on the marine environment would result from spilled oil. Oil spills have an almost catastrophic impact on the environment, besides being aesthetically undesirable. The effects on aquatic biota can be lethal as well as sub-lethal, and may last for months. Increases in turbidity and sedimentation and resuspension of toxic substances in bottom sediments will result from the construction and burial of pipelines. These will have negative impacts on many species of marine biota, especially filter-feeders. The various discharges from the drilling rigs represent another major impact. Drilling muds, drill cuttings and formation waters will all be discharged overboard.

Because of the vastly significant financial and economic aspects of OCS exploration and development, we realize the necessity for its implementation. However, this does not reduce our concern for the ecological considerations involved. We can only emphasize the great need for the proper environmental safeguards during all phases of OCS developments and for its ultimate consequences on nearshore areas.

In summary, it is our belief that potential impacts on Chesapeake Bay must be identified and addressed. In so doing, every effort must be made to uncover even conceptual plans for pipeline landfalls in, or close to, Virginia or alternate plans for transporting oil to ports in Chesapeake Bay. The sooner this is accomplished, the better will be the assessment of environmental impacts on the Commonwealth.

II. Adequacy of the Environmental Impact Statement Document

A. Detailed Comments

Volume I

P. 15 Second paragraph, third sentence: Why is off-loading of tankers into barges in estuaries not anticipated? It is occurring now.

P. 17 Table I-1 Land use requirements are estimated to be 160-645 acres. A report for API states that about 2500 acres is required. Brown and Root has recently acquired 2000 acres and is seeking zoning for heavy industry for 900 acres (included in the 2000 acres).

P. 42 A section on water is set forth and page 353 (Vol. 2) again lists water plans. Both these refer to wastewater.

P. 198 Third line: The statement relative to the capabilities of Hampton Roads underscores our contention that impacts on Chesapeake Bay must be included.

P. 226	1.8 *Oithona brevicornis* in this area is *Oithona colcrva* (Bowman 1975).
P. 226	Last line: add euphausids and salps to listed oceanic forms.
P. 229	Line 13: Elimination of *A. clausi* is due to temperature *exceeding*, not less than, its maximum for reproduction.
P. 230	Line 4: Fluctuation of *zooplankton* not phytoplankton.
P. 231	Line 17: Pelagic is appropriate term, not neritic.
P. 232	Table II-32.: *Oithona colcarva* not *O*. brevicornis.
P. 234	Table II-33: *Oithona colcarva* not *O*. brevicornis.
P. 234	Table II-35: No such species as *Paracalanus minutus*.
P. 235	Table II-35: Only one species of *Penilia*, *P. avirostris*
P. 238	Table II-36: No such species as *Pseudocalanus crassi rostris*.
P. 254 - 273	Benthic fauna - Generally fairly detailed and complete. The reliance on reviews, especially the URI review is evident. In some instances statements made in reviews have been attributed to presumed original sources incorrectly, for example, the statement attributed to Boesch, 1972 at the top of page 259 was a personal communication to Pratt and the statement attributed to Boesch, 1972 at the top of page 265 was in another paper. Fortunately these inaccuracies do not affect overall conclusions of the Environmental Impact Statement.

Volume II

P. 26	Line 19: The statement ignores predicted increases in energy use. Will OCS oil replace only current oil imports or potential future imports also? Do we know if there will be sufficient OCS oil to replace foreign imports?
P. 52 - 66	The spill trajectory models are useful but the fact remains that even the MIT model is a hypothetical model based on average events. Therefore, despite the fact that it is the best available model, it is essential to recognize its limitations in predicting the probability of onshore impact. It seems reasonable to assume that oil spills become more likely in extraordinary weather events - situations not

addressed by the model.

P. 70	First paragraph, last sentence: Formation waters also contain hydrocarbons and metals.
P. 97	First paragraph: The spills cited did not involve marshes and sandy beaches. The value of extrapolating ultimate effects is doubtful.
P. 98	Second paragraph: This paragraph ignores completely the productive bottoms and wetlands in the barrier island complex, a major omission.
P. 119 - 121	We cannot agree with the reasoning that there will be no impacts on Baltimore or Hampton Roads. There is no data to support this expectation; the amount of OCS oil is not know, the impact of increased energy usage has not been evaluated, and there are too many current indicators of a gearing up by the oil industry within Chesapeake Bay.
P. 165 - 169	In order to assess impacts, the discussion of refinery capacities should not be confined to 1976 capabilities. There are already announced plans to more than double the capability in Virginia. Crude oil must get to these plants somehow and from somewhere.
P. 209, 216-217	Second paragraph, second sentence: It is hazardous to state that it is less likely that primary industrial activity will occur in the Delmarva Peninsula. Why is Brown and Root seeking heavy industry zoning in Northampton County?
P. 238	First two sentences: A temporary population shift of beach users from an impacted beach to other beaches implies the availability of other beaches. In the Santa Barbara region of Southern California, the major beach users are from the Los Angeles area and they have a wide choice of public beaches. The use of public beaches in California cannot be extrapolated to Virginia where there are few public beaches and where the demographic situation differs considerably.
P. 333	Virginia has laws regulating uses of subaqueous areas as well as wetlands.
P. 348	Lists the four major types of onshore facilites that will be directly generated by OCS oil and gas activities.

These are:

1. Terminal and storage facilities
2. Onshore operations bases
3. Gas processing plants
4. Pipelines (onshore portions)

A fifth category of oil refinery is recommended.

P. 354 - 355 Sets forth State and local actions that may be taken pertaining to operational and locational factors and this is under the Pipelines section. The Commonwealth and the local governments should have this authority for all four (and the fifth suggested) categories listed in comment five.

P. 368 First paragraph: The Virginia Land Use Council has submitted a report to the Governor concerning the siting of key facilities including energy related facilities.

B. Format

Volume one contains a six-page "summary" labled H. Future Environment Without the Proposal. It is suggested that a companion short summary labeled Future Environment With the Proposal be added. Additionally, our review would have been greatly facilitated if the basic information of the two volumes and the maps had been consolidated in an accompanying "master" summary of perhaps 20 pages. Such a summary could contain an enumeration of areas of known fact, areas of uncertainty, and aspects for which additional research would be helpful. The summary could identify briefly the possible benefits and problems, and the mitigating measures appropriate to each problem. This type of summary would be useful to the various State executives and all others who must assess quickly the salient points of the entire discussion and arrive at conclusions leading to recommendations or policy formulation.

Also, in addition to the Table of Contents, a comprehensive index to the subject material discussed would assist workers in various disciplines in making their review.

7. Selected Other Comments Received

(in order of date filed)

AtlanticRichfieldCompany

Governmental and Environmental Affairs Division
515 South Flower Street
Mailing Address: Box 2679 - T.A.
Los Angeles, California 90051
Telephone 213 486 0741

J. L. Siva, Ph.D.
Science Advisor
Environmental Protection

January 23, 1976

Mr. Curt Berklund
Department of the Interior
Bureau of Land Management
New York OCS Office
New York City, New York

Dear Mr. Berklund:

The attached comments on the Draft Environmental Impact statement, proposed OCS lease sale No. 40 were prepared by Mr. D. W. Chamberlain and me. We hope that they will be of use to BLM in the preparation of the final Environmental Impact Statement.

Thank you for the opportunity to comment.

Sincerely,

June Lindstedt Siva

June Lindstedt Siva

JLS:fm

cc: F. D. Gealy
D. W. Chamberlain

LB
File

GENERAL COMMENTS

Description of physical processes extant in the Mid-Atlantic OCS is quite good and complete, generally, (salinity, temperature, circulation, ice, sea and swell, and water quality) although references for salinity and temperature are a bit dated (i.e. Bigelow and Sears, 1935 and Bigelow, 1933). These should be checked with more recent data, if available, for updating, trends, etc.

Table II-53 presents a very good summary of spawning characteristics in some Atlantic Coast fish species.

A listing of specific coastal wildlife habitats in New Jersey, Maryland, Virginia and Delaware and their particular importance is needed. (For example, see Odum, H. T., B. J. Copeland, and E. A. McMahan. 1974. Coastal Ecological Systems of the United States Conservation Foundation & NOAA. Vol. I, pp. 104-131).

There is a general need throughout for more factual supportive data or references for the hypothetical situations presented, i.e. "could happen," "would result," etc.

Names of authors should be listed.

SPECIFIC COMMENTS

Volume I

P.153, Paragraph 2.: 21°C is not a range of temperature. Is average temperature meant?

P.158, Second line from bottom: include also fluouescent dye as a tool in passive drift studies.

PP.178-197. Water quality problem areas in Figures II-46 to II-49 are difficult to place visually in respect to the Mid-Atlantic Coastal Region. A large-scale map is needed at the beginning of this section with which to reference these figures.

P.213, Table II-28: Does this figure include data for all three areas; ponds, embayments and offshore? If the areas are important in terms of communities this could be identified. The species could be ranked by their dominance in the community, i.e. 1, 2, 3, ... etc.

P.214, 7th line from bottom: instead of "... smaller species...." it should read "... smaller-size species..."

P.222, bottom paragraph: A better approach would be to correlate species shifts with season, temperature, and water quality changes.

P.224, 5th and 6th lines from bottom: change to read "Almost every phylum in the animal kingdom is represented in the plankton (TRIGOM, 1974).

P.225, Table II-31: this table should be completely revised. The list is not a complete one. It mixes phyla, and classes and orders and should be made consistent. Organisms should be grouped phylogenetically not alphabetically or otherwise. The table is not usable, as is.

P.226, last sentence: should read "The oceanic forms include, among others, the amphipods, ..."

P.231, 4th paragraph, 1st line: first would in sentence should be "Tychoplankters."

P.234, Table II-33: right-hand column heading should be "Habitat" instead of "Class." The latter has taxonomic implications.

P.236, Table II-35: this is a good table.

P.243, 2nd paragraph, 7th line: should read "Wulff et al. (1968) surveyed or catalogued species off Ocean City, Maryland."

P.255, Figure II-52: this is a good figure. More maps needed in other sections.

P.256: the species lists should be organized like the following table on p.257 which has good phylogenetic organization.

P.259-260: Species lists on these pages should be arranged and corrected to conform with table on previous two pages (pp.257-258).

P.262, bottom paragraph: should title be Sand Beaches? Rocky beaches have diverse flora and fauna.

P.271, Table II-51: Try to be consistent. Why no identifications on anemonies, hydroids, echinoids, bryozoans or tunicates?

P.273, lines 7 and 8: That fish communities fluctuate seasonally in temperate waters is not a unique situation and not really "especially true" for the Mid-Atlantic area.

P.273, line 10: Is the statement that there are very few year-round resident fishes true? Migration and emmigration in the area may be great but many other species, especially non-commercial, tidepool, estuarine, marsh, etc. benthic and pelagic fishes, are year-round residents.

P.273, line 12: Fishes can be catagorized ... "instead of" fishes are generally categorized..."

P.273, line 15: Change to read "... feeding on plankton and fish, herrings and mackerels for an example of the latter."

P.273, line 20: Change to read "...and usually more restricted..."

P.274, lines 1 and 2: Change to read "usually smaller species, including juveniles, of offshore species, found in shallow waters, tidepools, etc. and tolerant of wide ..."

P.274, line 5: Define diadromous.

P.274, lines 7 and 9: Change to read: "fishes are a very mobile group and sometimes difficult to categorize. Fishes of demersal or partially demersal habitat,"

P.274, Zoogeography: Some numbers for comparison are needed in this section. To what extent are the waters heterothermal? Are there quantitative estimates as to numbers of fish involved in the summer populations vs. winter populations? How do these compare with other "Heterothermal" areas? Do not "movement south" and "diffusion southward" mean the same? If so, then redundant.

P.275, Southern Summer Migrants: List all mullets, file fishes and pompanos by individual species.

P.276, line 2: Delete "...on commercial data..."

P.279, Little Skate: Young have been reported down to 50 fathoms in the Bay of Fundy (Leim and Scott, 1966).

P.281: Striped bass, Morone (Roccus) saxatilis.

P.284, Table II-54: Numbers presented are percent occurrence in what? Stomachs, trawls?

P.289, line 14: Define or delete the term "useful." Useful to whom?

P.291, Pelagic fish: Add to the list - plankton, in general (as ingested by filter feeders, i.e. anchovy, etc.).

P.293, paragraph 4: Replace the word "fish" with "their."

P.294, Right Whale: Burt and Grossenheider (1964). Separate this species into the Atlantic Right Whale, Eubalaena glacialis, and the Pacific Right Whale, Eubalaena sieboldie. Is this a valid split or is it now recognized as a single species?

P.295, line 11: Common seal should be Harbor seal.

P.295, line 20: Gray whale; should read Eschrichtius glaucus.

P.296, line 16: John Burns, Alaska Fish & Game, suggest Belukha as correct spelling instead of Beluga, as it is from the Russian (byelukha).

P.323, Table 11-62: This table should include the habitat of each species.

P.426-458, Tables 11-91 to 11-107: The tables of this section should also include the common names of each species listed in their respective headings.

P.442: Use summer flounder as common name for Paralichthys dentatus. This conforms with useage later on in the text. For the same reason winter flounder for Pseudopheuronectes americanus should be used instead of Blackback flounder.

P.447, 4th line: should read "The hake (or whiting) fishery...".

P.450, 2nd paragraph, 4th line: should read "...Mid-Atlantic Coast...".

P.450, 4th paragraph: Generic name of the striped bass is misspelled and should be Morone saxatilis. (Some workers use the genus Roccus, instead of Morone, for the striped bass.)

Volume 11

P.44, 2nd paragraph, last line: Mikolay should be spelled Mikoloj.

P.47, 3rd paragraph, 1st sentence: Bacteria, in general, are not necessarily distributed especially in oil spill areas but oil biodegrading bacteria might be. The reference should be (Kolpack et al., 1973).

P.50, last paragraph: References needed to support statements in this paragraph.

P.67: This section on water quality should also consider the effects of dilution. Quantify effects if possible. Assume worst case conditions or use water quality data from actual spills.

P.75: The impacts of oil spills on zooplankton communities are discussed. A good point is raised that there are seasonal changes in abundance of the different species of planktonic fish. (This same seasonality is seen in phytoplankton and zooplankton generally). Thus, the effects of an oil spill on plankters (algae, invertebrates, fish larvae) are, in part, dependent on the time of year the spill occurs. The discussion on P.75 and the table which follows, however, imply that fish larvae are more sensitive to oil pollution at certain times of the year, rather than that they simply are more abundant at those times. Perhaps the title of Table 111-21 could be changed from "Susceptibility on a seasonal basis for some fish species having planktonic larvae" to "Seasonal occurrence of planktonic larvae for some fish species". This puts the emphasis where it belongs; if there are more larvae in the water when oil is spilled, more larvae may be affected.

P.79, 1st paragraph, line 13: phytoplankton misspelled.

P.79, 2nd paragraph, 1st sentence: Citation should read "Oguri and Kanter, (1971)...".

P.81, 1st paragraph: A statement is made that most meroplankters (organisms that are planktonic for only part of their life cycle) are considered sensitive to environmental stresses and particularly vulnerable to oil spills since many are part of the "neuston" community. The neuston are minute organisms found in the surface film of seawater. While many meroplankters are indeed found in upper ocean waters, they are normally not found in the surface film, or neuston community.

P.81, line 5: Should read "Massive kills of planktonic...". Needs referencing also.

P.81, line 6: Change to read "Abundance of these same species have already been given on a seasonal basis (Table 111-21)".

P.81, 2nd paragraph, line 8: What is high? Planktonic organisms or formation water? How "high" will concentration of formation waters be? What will be the probable area of water affected? Can't this be modeled?

P.82, 4th paragraph, 1st line: Should read "...cuttings discharge could clog filter-feeding mechanisms of certain organisms,...". References to potential effect on "all of the nekton" needed.

P.83, 1st paragraph: Are the "general phytoplankton species" mentioned known to be susceptible or are they just there at these seasons?

P.83, last sentence: This is a good and accurate statement of those organisms most susceptible, but no components of the neuston community are mentioned.

P.85, 3rd paragraph: Toxicity is also dependent upon the components in the discharged water, not only upon dilution factors.

P.86, 1st line: An unknown effect could be the uptake of water soluble aromatics by what organisms? Plankton? Fish?

P.86, 2nd paragraph, 3rd line: Should read "...from increased turbidity are decreased rates of photosynthesis,..." Suppression implies an active rather than passive effect.

P.86, 3rd paragraph: The first sentence is unclear. Should be rewritten.

P.89, 2nd paragraph: Clarify by specific site in oyster bodies and in scallop muscles where the fuel oil was found. What are sufficient quantities? Expand on the Blumer and Sass (1972) information and provide quantities of fuel oil retained.

P.89, 3rd paragraph: Expand more on this information. "Reports" and "concludes" should be "reported" and "concluded" respectively to maintain consistency.

P.91, 2nd paragraph: This sentence rather awkward, rewrite to read, possibly, "Drill cuttings are separated from the drill mud and discharged into the ocean where they usually accumulate on the ocean floor." The paragraph needs more information because it is not possible to look up a personal communication.

P.91, 3rd paragraph: Is the reference Jones (1974) which is not cited in the bibliography supposed to be Jones & Williams (1973) which is cited?

P.92, 3rd paragraph: This cannot occur offshore. Oil won't sink if spilled offshore. To sink it must be weathered and agglomerated to sediments (suspended in water). If sediment concentrations reach 1-2% then sinking will occur. Even the asphalt (specific gravity 1.01 - 1.03) in oil would not sink in sea water (Sp.gr. 1.025).

P.93, 1st paragraph, line 7: Is this referring to intertidal communities? The whole sentence is unclear.

P.94, 2nd paragraph: Is "...possible onshore runoff..." from oil operations or other sources?

P.94, 3rd paragraph, line 9: Should read "...direct kill to benthic organisms is not likely..."

P.95: The impacts of near-shore oil spills on intertidal communities are discussed. Effects are said to be extremely variable, ranging from "nonexistent" to "extremely damaging." The differences in severity are attributed to chemical differences in the oil spilled, since it is well known that refined products are usually more toxic than crude oils. This EIS does not mention, however, another factor which is at least of equal importance, i.e., the type of intertidal community affected. Coastlines are diverse both physically and biologically, and some areas are more sensitive to oil pollution than others. More severe oil spill impacts have resulted when refined oils (like No.2 fuel oil) were spilled in highly productive, enclosed or semi-enclosed habitats.

P.97, 2nd line: Should read "Other mobile species such as...".

P.100, 2nd paragraph: Should read "...literature indicates that some marine algae are resistant to oil,...". Not all algae secrete mucus.

P.100, 3rd paragraph: The statement on recolonization mentions only the macro-forms. Succession begins with, (1) a bacterial film, (2) blue-green algae and diatoms, then (3) green algae followd by (4) brown forms, etc.

P.102, 2nd paragraph: The observations by Tendron (1969) need more explanation. Was decrease in fish numbers the effect of oil or dispersants? Could it have been due to normal seasonal fluctuations? Present how direct lethal effects were attributed to the oil.

P.104, paragraph 2: Fish larvae are not necessarily concentrated in the upper water layers, depths are variable with species. Many vertically migrate. Depths should be related to the depths and concentrations of water soluble hydrocarbon fractions below the spill. Give references to statement that fish larvae would be vulnerable to starvation if spill killed off their food supply.

P.104, paragraph 3: A reference is needed for this statement on chronic low-level discharge of oil into marine environment being potentially the most dangerous to fish. Expand.

P.104-105: Sublethal effects of oil pollution are discussed. Feeding, reproductive and social behavior in fish and lobsters are said to be disrupted by introduction of soluble aromatic derivatives in concentrations of 10-100 ppb. One reference, Todd, et al. (1973) is an unpublished manuscript, so I am unable to review it. I can find no mention of these effects in the other reference cited (Hasler, 1970). Hasler (1970) does refer to detergents as causing interference with chemoreception in bullheads (Ictalurus) at levels as low as 500 ppb.

Unpublished work on Ictalurus by Todd & Atena (1973) reports incitement of "conflict" behavior when fishes were exposed to water soluble fractions of Kuwait crude oil. No oil concentrations are given, however. Since this is unpublished work, perhaps this section could be expanded and/or the investigators contacted for an update on these experiments.

P.106, 1st paragraph: The water soluble fractions are diluted. This fact and uptake rates should be discussed also.

P.106, 2nd paragraph: Again, supply reference for effects of barium.

P.107, 3rd paragraph: References needed.

P.107, 4th paragraph: Name the species. Some herring such as the Atlantic herring and the Atlantic round herring are not anadromous but remain in the oceans. The blueback herring and the alewife are anadromous.

P.108, 1st paragraph: Does this mean that oil spills in these areas will affect spawning ability or block fish attempting to move to spawning areas upstream? If so, how? How will year classes be affected? Be more specific.

P.108, 2nd paragraph: Discharge of formation waters could alter what or produce what local changes? Is change in water quality meant? Elaborate on effects of water soluble aromatics at sublethal levels and provide reference.

P.109, 1st line: Should read "...marine mammals are not known."

P.109, 2nd paragraph: Should read "Connell (1973), however, ..."

P.109, 2nd paragraph, 7th line: Change to read "...LeBoeuf concluded that 68% of the dead sea lion pups...". While 45% of the live pups were 'oily'." Connell suggested that either pups with more oil have a greater chance of dying than those with less oil or perhaps dead pups pick up more oil on their skins than live ones. He suggested further investigation of this possible effect.

P.109, last 2 lines: Reference needed.

P.110: The statement in paragraph 2, "In view of the absence of breeding populations in the Mid-Atlantic area, however, these impacts should not occur." Conflicts with the following statement in paragraph 3 "In summary, spills would probably cause the greatest impact to marine mammals." This needs more discussion and clarification. Discuss also the likelihood of pesticide or toxic element resuspension, quantitative estimates of amounts that might be resuspended.

P.116, 1st paragraph: Would oil spilled offshore also be "borne away from land areas by the prevailing winds? Calculate chances of oil reaching shore.

P.134, 2nd paragraph: Removal of seafloor and pelagic commercial fishing areas by semi-submersible drilling rigs is a temporary effect, lasting only until drilling is completed. Areas remaining obstructed following drilling are those taken up by wellhead completions, etc. on the ocean floor.

P.135, 1st paragraph: Provide a quantitative comparison of estimated acreage removed to total acreage of the fishery. This would provide something quantitative on which to judge the extent of the impact to fisheries.

P.135, 3rd paragraph: Reference to Allen (personal communication, 1974) is not in the bibliography - perhaps as a footnote could be added to give more data on Personal Communications.

P.136, 2nd paragraph: Decline in commercial catches which have been documented are generally the result of fishing pressure itself or of natural cyclic phenomena (such as the decline of the sardine in California) or both.

P.137, 2nd paragraph: I doubt that the amount of damage to nets from oil activity debris can ever be predicted. How can you know the nature of a specific hazard that causes net damage without visible proof?

P.139, 3rd paragraph, line 3: Change finfish to fish. Delete the use of the word finfish throughout the EIS. It is an archaic term not decriptive of all teleost or chondrichthian species.

PP.134-150: Include a discussion of the effects of oil operations, including spills and other accidents, on commercial and sport fisheries. The section is written in terms of fishing interests rather than in terms of the fisheries themselves. For example, placement of offshore platforms, pipelines or underwater structures may remove a portion of the sea floor and pelagic areas from use by fishermen. This is viewed in the EIS as a negative environmental impact because some types of fishing (e.g., trawling) may not be possible in these areas. This may have adverse impact on the ways fish can be harvested, but it certainly would not have an adverse impact on fish populations, which would probably increase.

Fishing pressures increase as more efficient fishing techniques are developed, and commercial catches are declining in most U.S. waters. Anytime fishing pressure is reduced, recovery of fish populations in affected areas can take place, provided other conditions are favorable. Even if no recovery were to occur and population levels remained stable, at least further decline due to fishing would be prevented. If fishing cannot occur in a given area, the net effect is bound to be a beneficial one on fish populations there. All of these impacts should be discussed in the EIS.

On P.139 the statement is made that oil spills may physically prevent fishing in contaminated areas for months. As just stated the effects of decreased fishing pressure in affected areas should be considered in addition to the possible toxic effects of oil on fishes or their food supply.

Moreover, has an oil spill ever prevented fishing for months? What are the chances that an offshore area would remain contaminated for months? Santa Barbara harbor was closed during part of the month of February 1969, at the time of the blowout. Landings increased at nearby Oxnard harbor during that month, however (Straughan, 1971).

Speculations in the report that adult fish would be affected by oil-caused "food-web interruptions", lowered resistance to environmental stresses and massive kill-off of larvae and juveniles should be documented. Is there substantiation for these opinions in the literature? This documentation is particularly important since the authors of this report are not identified.

Inasmuch as "significant amounts of sport-fishing activity does not occur in the areas tentatively proposed for leasing" (P.140), the 6 impacts on sports fishing listed on P.140-141 seem overstated.

The great distance of platforms from shore would probably limit their use as sport fishing grounds. This would reduce the beneficial impact to sport fishermen (but not to fish and invertebrate populations). Impacts 2,3, and 4 on oil spill and dredging or construction effects are highly speculative and should be documented.

P.140, 1st sentence: Change to "...complete depuration to no depuration after six months in clean water."

P.140, 1st paragraph: There is now much evidence on the time required for molluscs and bivalves (use these terms in place of shellfish) to cleanse themselves. Reference a more thorough discussion.

P.140, b. Sport Fisheries: (1) ...reefing effect should be reef effect. (2), (3) & (4), these situations should be documented by references or illustrated by the presentation of hypothetical situations based on observations.

P.141 (5): This has been documented at least once, e.g., Santa Barbara.

P.141, 3rd paragraph: This statement implies that those situations will result from oil activities. In most, however, there is little or no data available at this time to indicate such results generally occur from oil spills. This is not to suggest that such will not be the case, but once again, hypothetical situations, should be based on facts, and these should be stated and referenced.

P.141, 3rd paragraph, line 5: Suggest changing to "...provide both food (following a variable time period for succession of prey populations, etc., to develop) and cover..."

P.142, 2nd paragraph: Platforms could be made into refuges, why not consider this?

P.143, 2nd paragraph: Again, these are hypothetical situations which could take place. Without factual data for support, the converse could be postulated and equally be true, i.e., that there would be no effect. Statements like these warrant supportive facts or plausible hypotheticals. Document with references.

P.144, 2nd paragraph: The reduced fishing pressure would be a plus for the fish populations under fishing pressure if other factors did not cause adverse impacts.

P.145, 2nd paragraph: Other variables which affect spill impact are the types of hydrocarbons spilled, climate and sea state.

P.149, 2nd paragraph: Don't you mean that shoreline use could limit accessibility to beach fishing areas?

P.150, 2nd paragraph: Does dislocation of fish populations by nearshore oil spills occur? Documentation desirable. Limiting access to an area by an oil spill over sport fishing grounds or by forced closing of a harbor is more important (to sports fishermen) than dislocation of fish populations, if in fact the latter does occur.

P.229: Discuss in this section the likelihood of oil reaching beaches in each yearly season. Also the effects of prevailing winds and currents relating to oil spill movement should be discussed.

P.231, bottom paragraph: Cite reference or references relating to the minimal probability of oil spills coming ashore.

P.254, 1st paragraph: Cite preliminary data of the Virginia Institute of Marine Science on wetlands.

P.255, 2nd paragraph, line 3: Change to read "...penetrate into plants via the stomata (pores)."

P.256: Check with A. Michael (WHOI) for follow-up studies on recovery of West Falmouth marsh.

P.256, 1st paragraph: Should include scientific names of all species mentioned.

P.257, 2nd paragraph: Estimate, if possible, the length of time marsh communities will be "destroyed". Will it be forever? Also the impact on the areas adjacent to construction sites. Clarify "...a long time to recover." What about rehabilitation of disturbed areas?

P.259, 6th & 7th lines from bottom: Estimate length of time over which oil will not be totally degraded.

P.259, 3rd line from bottom: Improper use of the term "ecological." More accurate to use "environmental." Ecology is the science of relationships between organisms and their environment. Environment is something that surrounds, extrinsic conditions.

P.262, bottom sentence: Bird migration and its effect on populations should also be discussed as it relates to their recovery.

P.263, line 9: Discuss the likelihood of oil reaching shore.

P.263, last sentence: Most birds are found near-shore. How likely is the Atlantic Flyway to be affected by a spill? Platform? Pipeline?

P.264, 4th line from bottom: Should read "...loss of habitats and other environmental disturbances."

P.265, 2nd paragraph, lines 3-4: This sentence is a little awkward perhaps state it this way "...receive the greatest impacts, and mortalities can be high as previous..."

P.266, 4th paragraph: References needed.

P.267, line 7: Beyong should read belong.

P.269: A reference is made to effects of low levels of oil in "the marine ecosystem" on "beach-utilizing" mammals. Specifically, the suggestion is made that such oil may be responsible for causing "premature births in seals with a resultant death of pups." Unfortunately, no reference is given. DeLong, Gilmartin and Simpson (1973), correlated high levels of organochloride pesticides (not oil) with premature births in the California sea lion. If this is the work referred to, it is misquoted. At any rate, the importance of citing references cannot be overemphasized.

P.269, 3rd paragraph, last line: There is at least one paper now which treats this subject (Crocker, et al., 1974).

P.271, line 14: Should read "...could cause the loss of some mollusc beds..."

P.341-343: This section should be expanded to include information on oil spill cooperatives, specific limits of cleanup equipment (due to wind, sea state, etc.), and planning (contingency plans, identification of vulnerable ecosystems, etc.).

P.367, paragraph 3: (Grummet, no date) not in references.

P.385, paragraph 1: There are a number of papers now available which deal with depuration of hydrocarbons in various organisms.

P.385, paragraph 2: At what concentrations of oil is tainting noticeable? Address effects of decreased fishing effort on fish populations.

P.445, paragraph 2: Impact will not be uniform. Desert areas, because of the land area available, relatively high number of cloud-free days, flatness, etc., will likely feel the brunt of the landuse for this energy source. As long as the collectors are in place, this land is removed from any other use (esthetic, etc.). Although surface mining may cause more physical disturbance of the land, reclamation can start immediately after energy resource extraction.

Appendix 9

P.623: List name(s) of author or authors for Appendix 9. Available? A good idea for the rest of the EIS.

P.625, paragraph 3, line 5: Are all saturated hydrocarbons known to do this?

P.625, paragraph 3, line 10: Should read "In organisms, the biogenic alkanes of...".

P.627, paragraph 4: Some quantitative information on the concentration of these nonhydrocarbon compounds in petroleum would be desirable. What are their levels in crude oil?

P.629, paragraph 2: Uptake varies with species of organism.

P.630, paragraph 2: The citation for Yevich and Barry (1970) is not complete in the References for Appendix 9.

P.633, paragraph 3, 1st line: Were not these taken up and accumulated under high exposure conditions?

P.641, paragraph 2, line 10: Suggest astronomical be changed to relatively large, great, etc.

P.649, paragraph 2, line 1: Scarrot should be spelled Scarrat.

P.650, paragraph 2, line 11: Should read "...liver-like organ in some invertebrates,...".

P.655, paragraph 3: Again personal communication of Rice (1975) not in references, perhaps should be a footnote.

P.656, Figure 3: Does this figure show data for oysters or mussels or pooled for both? Not clear.

P.657, line 5: In expressing the concentration of fuel oil, which should it be; 106 mg/l or 106 ppb? They are not the same, mg/l =

ppm. Are the other quantities in this paragraph mg/g?

P.658, Figure 4: Small numbers in Graphs A & B are difficult to read.

P.662, paragraph 4: This is not really a very obvious implication of oil spills without more data. There is little or no data showing that this could happen. This paragraph should be written in more speculative terms unless supported by references.

P.663, paragraph 2: For more information see Kinney, Button and Schell (1969) and Button (1974).

P.665, paragraph 4: Oxygen transfer though oil is rapid. Button (1974) suggests that biodegradation is diffusion controlled with temperature having little effect as long as oil-water mixtures are not frozen.

P.669, paragraph 2, line 7: Do you really mean equivalent, or similar? Yevich misspelled twice on this page.

P.671, Table 4: All heavy metals normally found in seawater are not listed, i.e., Antimony, Aluminum, Gold, Tin and Titanium.

P.672, line 9: Should read "...are ingested or taken up at sufficiently..."

P.690, paragraph 2: Expand this discussion, identify species studied. Perhaps a table would be helpful.

P.690, paragraph 2, line 1: Use fish instead of finfish.

P.690, paragraph 2, line 2: Should read "...tissue of these Osteichthys species...".

P.690, paragraph 2, line 4: Should read "...tissues of Chondrichthys species studied tend to be...".

P.691, paragraph 2, line 7: Should read "...sea urchin embryos (Strongylocentrotus purpuratus)..." instead of "sea cucumber embryos...".

P.693, paragraph 3, line 6: Delete L. from (Carcinus maenas L.).

P.697, paragraph 2, line 3: Delete the use of the word finfish. Sentence should read "...metals in various fish species."

Literature Cited:

BURT, W. H. & R. P. GROSSENHEIDER, 1964. A Field Guide to Mammals, Houghton Mifflin Company, Boston. PP-258-259

BUTTON, D. K. 1971. Biological effects of petroleum in the marine environment. D. W. Hood (Ed.) Impingement of man on the oceans, PP-421-429. John Wiley & Sons, New York.

BUTTON, D. K. 1974. Arctic Oil Biodegradation, Dept. of Transportation. U. S. Coast Guard. Office of Research and Development, Washington, D.C. Report No. DOT-C6-24722-A. 60 p.

CROCKER, A. D. *et al* 1974. The effect of a crude oil on intestinal absorption in ducklings (*Anas platyrhynchos*). Environmental Pollution, 7:165-177.

DeLONG, R. L., W. G. Gilmartin & J. G. Simpson (1973). Premature births in California sea lions: Association with high organochloride pollutant residue levels. Science 181:1168-1170.

HASLER, A. D. (1970). Chemical ecology of fish. In Sondheimer, E. and J. B. Simeone (eds). Chemical Ecology. Academic Press, N. Y. & London. 219-234.

KINNEY, P. J., D. K. BUTTON & D. M. SCHELL (1969). Kinetics of dissipation and biodegradation of crude oil in Alaska's Cook Inlet. Joint conference on prevention control of oil spills, Proc. Amer. Petrol. Inst.-Fed. Water Pollution Control Ass., Dec. 1969. Amer. Petrol. Inst., New York, N. Y.

KINNEY, P. J., D. K. BUTTON & D. M. SCHELL (1969). Dissipation of oil spills in Alaska's Cook Inlet. Inst. Mar. Sci. Report R69-16, Univ. Alaska. Fairbanks.

LEIM, A. H. & W. B. SCOTT (1966). Fishes of The Atlantic Coast of Canada. Fish. Res. Bd. Canada. Bull. No. 155, P.52.

ODUM, H. T., B. J. COPELAND & E. A. McMAHAN (1974). Coastal ecological systems of the United States. Conservation Foundation & NOAA. Vol. I-pp. 104-131.

STRAUGHAN, D. (1971). Oil pollution and fisheries in the Santa Barbara Channel. In Straughan, D. (ed.). Biological and oceanographical survey of the Santa Barbara Channel oil spill, 1969-1970. Allan Hancock Fdn., USC publication: 245-254.

TODD, T. H. *et al* (1972). An introduction to environmental ethology. WHOI-72-43. Unpublished manuscript, Woods Hole Oceanographic Institute.

TODD & ATENA (1973). Unpublished work, Woods Hole Chemotaxis group.

National Wildlife Federation

1412 16TH ST., N.W., WASHINGTON, D.C. 20036 Phone: 202—797-6800

January 28, 1976

Manager, New York Outer
  Continental Shelf Office
Bureau of Land Management
6 World Trade Center, Suite 600-D
New York, New York 10048

Sir:

The National Wildlife Federation requests that the comments which follow be made a part of the record of the hearing on the proposed Mid-Atlantic Oil and Gas Lease Sale offshore from New Jersey and Delaware, OCS #40.

It is our understanding that the draft environmental impact statement (EIS) covers 154 tracts consisting of 876,750 acres chosen for a proposed lease sale in the Baltimore Canyon Trough located from 54 to 109 miles offshore in waters from 118 to 571 feet deep.

From the viewpoint of policy, the National Wildlife Federation is of the conviction that energy requirements should be met with means which are the most efficient and economical and least harmful to the natural environment. Further, this organization believes that energy conservation must be an essential element in a national energy policy, with high priority given to research and development on clean and safe sources of power independent of other countries while conserving valuable fossil fuels for other beneficial purposes. Specifically, the National Wildlife Federation recommends that offshore oil exploration and production be undertaken only after: 1. their locations are coordinated with overall onshore land use or coastal zone management plans by units of government at all levels which fully protect public recreational and wildlife values; 2. wells are fully equipped with fail-safe spill preventive devices; 3. assurances are provided for inspection and monitoring of safety precautions by responsible governmental officials; and, 4. bonds to ensure containment and cleanup of spills are required.

The foregoing is set out in order to identify the context with which the EIS has been considered by our organization.

In our opinion, it is essential that the Interior Department in a final impact statement spell out its intentions for safeguarding the environment before any drilling is initiated. The industry should know what it will be required to do in the stipulations before any sales are consumated. In a similar manner, the public has a right to know what the environmental safeguards will be before any sales are consumated.

It is our fervent hope that the Department of the Interior will be guided by concerns for the environment as well as by wishes of the oil industry. We feel that the Council on Environmental Quality performed an admirable service in identifying "high risk" areas which should be avoided. Consequently, we recommend that the Interior Department pursue a policy of going slow in order to learn as much as possible from experience before another is undertaken.

Our organization also is of the conviction that the Interior Department must not sell more leases than the oil industry can handle, due to shortages of equipment and other factors. There is no valid reason for sales which cannot be activated for periods of years. Consequently, it is our recommendation that, if it is determined that a Mid-Atlantic lease sale is necessary, the sale be drastically reduced in scope and limited to the area which requires the least number of operational bases and poses the fewest possible environmental hazards. Further, we recommend the sale be delayed until: 1. coastal zone plans are developed and implemented; 2. environmental baseline studies are completed; and, 3. assurances are firm on applying the latest and most effective techniques to contain and remove oil that is spilled.

It is our purpose to make general comments about the EIS initially, and then direct attention to the views on the specific points contained in Section 102(2)(c) of the National Environmental Policy Act (NEPA) as requested by the Department of the Interior.

General Comments

The amount of information assembled by the Bureau of Land Management on the proposed 1976 outer continental shelf oil and gas lease sale offshore the Mid-Atlantic States is impressive. It would appear that much of the published and unpublished information bearing on this subject has been presented in volumes 1 and 2 of the report; and the three "visuals" constituting volume 3 are useful for orientation purposes. Some of the material presented is somewhat peripheral to, or only indirectly related to, the proposed lease sale. Also, there is considerable duplication of information within the 1342 pages of text. Overall, however, BLM is to be commended upon the quality of the report.

It is to be expected that within the time available for BLM to prepare this report, some relevant reports would be omitted from the 41-page bibliography. Also, new publications relating to the subject are appearing which make continued updating of the information desirable. For example, Selected Water Resources Abstracts, Vol. 8, No. 22, dated November 15, 1975, contains several relevant abstracts to articles not included in the bibliography. Among these are two dealing with the toxicity of petrochemical drilling fluid components and wastes to fish and to aquatic biological systems, a problem area in which compilers of the EIS indicated there was a scarcity of information. If Selected Water Resources Abstracts published by USDI's Office of Water Research and Technology has not been reviewed in the preparation of the EIS, the eight volumes now available might contain other valuable information. Also, we noted in the December, 1975, issue of The Wilson Bulletin (Vol. 87, No. 4, pages 467-480) an article by Kees Vermeer and Gary G. Anweilen entitled "Oil Threat to Aquatic Birds Along the Yukon Coast." Although this deals with a different geographic area, some of the information presented would be pertinent to the Mid-Atlantic Bight and the articles' "Literature Cited" section contains many other references not included in the EIS bibliography.

Thus, despite the fact that the EIS indicated extensive consultation, collaboration and cooperation among Federal, State and local government agencies and private firms and conservation organizations in the preparation and review of the original draft statement, it is obvious that additional relevant information could be obtained, given the time to do so.

1. The Environmental Impact of the Proposed Action

Volume 1 of the EIS consists largely of descriptions of the proposal and of the existing environment and man's use of the environment. This is well done. A brief section, pages 553 to 558, discusses the environment and possible future socio-economic trends in the area without the proposed sale and oil and gas development. It is stated that without proposed OCS Sale #40, pressure to provide new sources of gas and oil may lead to leasing efforts in State waters where stratigraphic traps which undip from the deeper sedimentary section of the Baltimore Canyon Trough may have accumulated hydrocarbon deposits within the State three-mile jurisdiction. The EIS compilers indicate that State production would result in many of the same impacts that are discussed in the impact statement but, because State production would be closer to shore, greater dangers to coastal areas due to oil pollution could be expected. There appears to be some validity to this conclusion, if there is any offshore oil production at all.

The likelihood of commercially available quantities of gas and oil occurring in State waters was not elaborated upon in the geologic treatment in the EIS, and potential development in State waters was not included in the discussion of alternatives to the proposed action. Further information from USGS on the possible occurrence of gas and oil near shore might be desirable to help round out the picture. Also, the effects of oil spills from tankers used in importing oil from foreign sources on the biological resources should be given in more detail.

Possible environmental impacts of exploratory and development wells for gas and oil and effects of production on the offshore and onshore environment were generally well described. There was a frank admission that there were many unknowns and considerable uncertainty as to some of the environmental impacts. Some of these are identified under the heading of "Recommendations" in these comments on the EIS.

As indicated on page 392 of volume 2 of the EIS, there would be no long-term productivity or environmental gains with regard to national resources expected as a result of this proposed sale--very likely, the opposite--but benefits as a result of the proposed action are to be expected as a result of increased supplies of domestic oil and gas. We note, (page 19, Volume 1 of the EIS) that the overriding factor in planning for OCS leasing is to strive for a supply of oil and natural gas adequate to meet the demand for these resources, consistent with the protection of environmental values. We are pleased to note that BLM, in developing its OCS planning schedule, took cognizance of the Council of Environmental Quality's environmental risk reports of Gulf of Alaska and Atlantic OCS; of Interior's survey of industry, State and local governments and interested members of the public concerning resource potential and environmental risks; and of ecological resource data gathered in seismic surveys of these areas. Although consideration is given to rare and endangered species which might be affected by oil spills and other consequences of gas and oil development, we believe that every precaution should be given to the protection of such species. The fact that few of the endangered marine mammals occur in the Mid-Atlantic area increases the need for such precautions. The mitigating measures to be included in the proposed action (pages 312-368 of Volume 2 of the EIS) are commendable as ways of avoiding unnecessary degradation of the habitat, but they do not indicate what can be done, if anything, to replace or make up for any damages done.

2. Any Adverse Environmental Effects Which Cannot be Avoided Should the Proposal be Implemented

As stated above under "Environmental Impact of the Proposed Action," this section of the EIS is well prepared. It reviews some of the material, and admits lack of desirable information on many aspects of environmental impacts, such as drilling mud and cuttings, oil spill, resuspension of sediments, effects of chronic, low-level discharges of oil, possible effects on rare and endangered species, cumulative and synergistic effects, etc.

3. Alternatives to the Proposed Action

Of the several alternatives suggested (pages 397 to 476 of Volume 2 of the EIS), withdrawal of the sale might be the most advantageous from an environmental standpoint, but the benefits would have to be weighed against dependency on foreign imports, political implications, environmental damage resulting from use of other energy sources, etc. Assuming that an oil and gas lease sale in the Mid-Atlantic region will be deemed necessary, then we believe careful consideration should be given to (a) limiting the sale initially to the suggested 216,341 acres mostly offshore of Delaware which would require fewer operation bases and reduce hazards, including onshore effects; and (b) delaying the sale, pending implementation of coastal zone management plans, completion of environmental baseline studies by BLM and studies concerning the potential environmental impacts of offshore minerals development, and, pending possible development of improved equipment to provide increased environmental protection from oil spills. As indicated in the EIS, holding of a smaller scale sale would permit gradual adjustment of the Zone planning in anticipation of future lease sales. Delay of sale would permit completion of existing and planned studies, up-dating of information and better coordination among Federal and State agencies and among State agencies themselves. We are not recommending specifically that either of these alternatives be taken, but that they be given careful reconsideration.

4. Relationship Between Local Short-term Uses of Man's Environment and Maintenance and Enhancement of Long-Term Productivity

It seems obvious that extraction and consumption of oil and gas would preclude their use at a later date and lower reserves for the future. Their extraction probably would degrade to an unknown extent the quality of the environment, at least locally, both on-shore and off-shore. It is likely that some adverse and some beneficial socio-economic impacts would result. We would be concerned particularly about any on-shore developments that despoiled coastal wetlands or about long-term adverse effects on the marine environment due to continued low-level chronic pollution. The analysis of short-term uses of man's environment and enhancement of long-term productivity occupying only three and one-quarter pages (389-392 of Volume 2) should be bolstered with more information, if possible.

5. Irreversible and Irretrievable Commitments of Resources Involved in Implementing Proposal

As indicated in the EIS (pages 393 to 396 of Volume 2), the proposed action could represent an irreversible and irretrievable commitment of hydrocarbon resources; remove a portion of the area from which other resources such as sand and gravel could be mined; utilize up to 645 acres of land (onshore) for OCS-related facilities as well as acreage for pipeline rights-of-way; possibly result in loss of an endangered species; to the extent that resources such as steel products, specialized manpower, etc. are used to develop this proposed Baltimore Canyon sale area, other opportunities for their use might have to be foregone; some human casualties and deaths very likely would occur; and some archeological and historical resources probably would be lost or reduced in value. Again, we would urge that measures be taken to avoid use of coastal wetland areas for onshore facilities in such a way as to degrade or destroy them. Furthermore, we urge that recreation and tourism values be given careful consideration in land use alterations or in activities that conflict with these interests.

Other Comments and Recommendations

Regardless of whether the proposed OCS Sale #40 is conducted with consequent exploratory and development drilling and production, or one of the alternatives such as delay of sale or reduction of acreage involved in the sale is taken, we recommend continued and accelerated research and monitoring to provide a better basis for future planning and decisions regarding OCS leasing. This recommendation is based, in part, on the many frank admissions of lack of adequate information on environmental impacts mentioned in the EIS, including the following:

1. Conflicting information on the importance of sediment transport and scour in relation to oil well platforms and pipelines--pages 88-90 of Volume 1. "Bottom sediment transport represents one major subject area where comprehensive programs of research are needed." (Vol. 1, p. 91).

2. "The phytoplankton community of the area is very diverse . . . although the floristic characteristics of onshore waters are fairly well known for certain geographic areas (not for all), very little is known for offshore waters." (Vol. 1, p. 212).

3. Although there are records of some oil tanker sinkings in the subject area between 1940 and 1972, including some during World War II, (Vol. 1. p.550) . . . "There have been no efforts to determine the long-term effects of these spills." (Vol. 1, p. 552). It is implied in the EIS that dangers of oil spill from tankers is greater than for leaks from or accidents to pipelines, but good documentation in the EIS appears to be lacking.

4. With respect to damage to pipelines due to natural phenomena such as ground faulting and slumping, the possible loss of soil stability cannot be assessed until a thorough geologic analysis of the selected routes has been made and a value location progam selected. (Vol. 2, p. 33).

5. "Much work remains to be done to elucidate the effects (disposition of degradation) of oil in sediments, especially in deep sea sediments. (Vol. 2, p. 50).

6. "Oil spills, by far, pose the largest threat to the biota and could occur from pipeline ruptures, blowouts, explosions and transportation accidents . . . It should be mentioned that the evidence for possible impacts on marine ecosystems is derived primarily from laboratory studies and they may or may not apply to the natural environment. (Vol. 2, p. 74).

7. The sensitivities of fish larvae to hydrocarbons will vary depending on species; litle is known about the effects on them. (Vol. 2, p. 80).

8. Discharge of formation waters will be most harmful and lethal to the plankton in the immediate area of discharge. In addition to high concentrations of dissolved salts and low-levels of dissolved oxygen . . . "An unknown effect could be the uptake of water soluble aromatics not removed in the separation (treatment) process." (Vol. 2, p. 86).

9. "The barium and chromium in drilling muds is thought to be harmful to marine biota, but its effects to date have not been determined." (Vol. 1, p. 91).

10. "The sublethal effects from oil pollution, especially from the chronic low-level discharge of oil into the marine environment, are the least known and potentially the most dangerous to fish. (Vol. 1, p. 104).

11. "The effects of oil on marine mammals is not known. Due to their scarcity and very infrequent visitations to the Mid-Atlantic area, however, impacts upon them, if any, should be minimal." (Vol. 1, p. 109). One wonders, however, about possible impact on rare and endangered species.

12. "There is insufficient information available to evaluate the long-term and indirect effects of oil spills upon small mammals." (Vol. 2, p. 268).

13. The brown pelican, Southern bald eagle, American peregine falcon, and Eskimo curlew are bird species which, on shore, might be adversely impacted by their ingestion of oil-contaminated food. "The actual effects resulting from ingesting contaminated food are unknown at this time." (Vol. 2, p. 270).

14. With respect to cumulative impacts to marine organisms brought about by additional sales and increased levels of production following the potential discovery of commercially available oil and gas, it is stated, Vol. 2, p. 306: "For example, if the amount of chronic oil pollution or other effects of activities resulting from a first sale (possibly in combination with other factors) were enough to reduce a population to a critical level, then any activity could be expected to result in the destruction of that population. However, understanding of the complex relationships of the various living and non-living components of the marine environment and the effects of OCS oil and gas development on them are not, in general, sufficient to allow identification of the cumulative impact of additional sales."

15. Although more than 75 percent of most petroleum is composed of hydrocarbons, many other compounds (some toxic) are present. Very little research has been done on effects of these nonhydrocarbon components on aquatic organisms or on degradation of these substances. (Vol. 1, p. 627).

16. Microbial degradation of oil occurs but much is unknown about processes and details. (Vol. 1, p. 663).

17. There is uncertainty as to the direct carcinogenicity of crude oil and crude oil residues in marine organisms as far as man, as potential consumer, is concerned. (Vol. 1, p. 663).

18. "At present little is still known about the pathways of uptake, metabolism, storage and release of heavy metals and their transport through the marine ecosystems." (Vol. 1, p. 691).

These excerpted or quoted passages, although perhaps taken out of context and without qualifying or explanatory comments which accompanied some of these examples, would seem to indicate urgent need for continuing research. Not only do they demonstrate the lack of desirable information, they also indicate objectivity on the part of authors of the EIS. We believe as many as possible of the gaps in information should be filled before becoming too extensively involved in the actual drilling and production activities.

Sincerely,

Thomas L. Kimball

THOMAS L. KIMBALL
Executive Vice President

MONMOUTH COUNTY ENVIRONMENTAL COUNCIL
MONMOUTH COUNTY PLANNING BOARD

Neal MUNCH
CHAIRMAN
Kathleen H. RIPPERE
VICE-CHAIRMAN
Freda MERCER
SECRETARY
Robert W. HUGULEY
STAFF

THE BOARD OF CHOSEN FREEHOLDERS MONMOUTH COUNTY NEW JERSEY

Edward J. ARBACZAWSKI
Jane B. BLAISDELL
Lester S. GOLDSTEIN
Dr. Russell G. GROSHANS
John W. Mc CAFFREY
Edward MILLER, M.D.
Lionel SCHUSTERMAN
Elethea SPANG

MONMOUTH COUNTY ENVIRONMENTAL COUNCIL STATEMENT ON THE DRAFT ENVIRONMENTAL STATEMENT BY THE UNITED STATES DEPARTMENT OF THE INTERIOR FOR THE PROPOSED 1976 OUTER CONTINENTAL SHELF OIL AND GAS LEASE SALE (OCS SALE NO. 40)

January 30, 1976

ONE LAFAYETTE PL., FREEHOLD, N.J. 07728 • 201-431-4000 EXT. 220

"THIS IS 100% RECYCLED PAPER"

SUMMARY

(1) The Monmouth County Environmental Council is deeply concerned over the potential impacts of off-shore oil exploration and drilling on near shore estuarine habitats, the county resort industry, and general land use impacts.

(2) The Environmental Council recommends that water (brines) produced with oil and gas be either reinjected into the wells or reclaimed as much as possible.

(3) The State of New Jersey should have control over where the oil platform -- to shore oil and gas pipelines go and how they are to be placed, buried, monitored and repaired.

(4) Any necessary oil refinery expansion should be done vertically rather than horizontally. That is to say expansions should be on site with no new refineries permitted in the region.

(5) There should be a Federally backed no-fault guaranteed oil spill clean up program, to clean up oil which moves into coastal regions, beaches and estuaries.

(6) There should be a Federally backed program to compensate municipalities and businesses for losses suffered due to any oil spills caused by off-shore drilling, production and transmission. Such a program would prevent catastrophic losses to hard pressed coastal resort towns and businesses.

The Monmouth County Environmental Council is deeply concerned over the potential impacts of off-shore oil exploration and production on near shore and estuarine biological communities, coastal beaches, the County resort industry and general land use impacts. Monmouth County has a shoreline of more than thirty (30) miles. This shoreline includes both ocean and bay frontages as well as some of the most scenic and productive estuaries in the region. In addition the shoreline areas are predominantly residential and resort related and contain little industry. Thus if there is any significant oil production the impact on Monmouth County could be substantial.

In view of these considerations this statement will touch on four (4) major areas of concern. These are areas where we feel that Monmouth County could be directly affected.

I. Production of Water Brines From the Platforms

According to the Department of the Interior Draft EIS, Vol. II, page 15, water (brines) are produced along with the oil at an approximate rate of one to one. These brines are contaminated with oil. The Draft EIS estimated a maximum discharge of 930 gallons of oil per day into the marine environment due to the oil-brine mixture, as these brines are normally discharged into the water. Over a period of one year such discharges would amount to more than 8000 barrels of oil. The Environmental Council is concerned about such continuous discharges of oil into the environment and the possible effects such oil may have on basic biological organisms such as plankton, larval forms of food fish and coastal marsh grasses. The Council recommends that:

(a) Such brines be reintroduced into offshore wells as much as possible.

(b) Where reintroduction into wells (injection) is not feasible, the brines should be treated to remove a large percentage of the contaminants.

II. Oil and Gas Pipeline Construction

In the draft EIS it is stated that the Interior Department has no jurisdiction in state waters and cannot require burial of oil and gas pipelines. The Interior Department does however have a say in where such pipelines go in out-of-state waters. The Environmental Council urges that all pipelines be buried or otherwise placed so that coastal fishing operations and lobstering operations are not disrupted. As it is off-shore oil and gas exploration will effect coastal fishing operations to some extent. Federal and State regulation of such operations will help minimize these impacts.

III. Refinery Expansion

Although it is emphasized in the Draft EIS that all new Atlantic OCS oil will replace presently imported oil there is still a likelihood that with a new source of energy, regional demands will increase. Thus there would be a need for increased refinery capacity. The Environmental Council urges that the Federal or State Government regulate such expansion and require refinery expansion to take place in a vertical rather than horizontal mode. That is to say refineries can (with present technology) expand their facilities without requiring any additional land. Such a policy would prevent any new refineries from locating in "new" residential or rural areas outside of the urban north New Jersey industrial-commercial complex.

IV. Oil Spill Cleanup and Liability

The Monmouth County Environmental Council is concerned over the impacts oil spills would have on coastal beaches and the important resort industry in the County. For this reason the Council feels that there should be Federally backed no-fault guaranteed oil-spill clean up procedure, to clean up and remove oil which enters coastal regions, estuaries and onto the river, bay and ocean beaches. This way any spill will be cleaned up quickly and without an argument over responsibility or fault.

To further this aim of protecting the resort and resort related segment of the County economy the Environmental Council urges the establishment of a Federally backed program to compensate municipalities and businesses for losses suffered because of any oil spills caused by off-shore drilling, production or shipment. Such a program would prevent catastrophic losses to hard pressed coastal towns and resort related businesses.

The Monmouth County Environmental Council feels that if the points addressed in this statement are properly considered by the Federal and State governments, then ecological impacts from off-shore oil exploration and production can be minimized. The Council recognized the fact that any land use impacts will be governed by local land use controls and zoning. However through coastal zone management and planning on the Federal and State levels many potentially adverse impacts may be eliminated.

OFFSHORE OPERATORS COMMITTEE
POST OFFICE BOX 50751
NEW ORLEANS, LOUISIANA 70150

C. E. GOLAY, CHAIRMAN
1111 TULANE AVENUE
NEW ORLEANS, LA. 70112

R. C. VANBIBER, JR., VICE-CHAIRMAN
P. O. BOX 60626
NEW ORLEANS, LA. 70160

JACK JONES, SECRETARY-TREASURER
P. O. BOX 60252
NEW ORLEANS, LA. 70160

February 6, 1976

RECEIVED
FEB 1 1 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

Director (732)
Bureau of Land Management
Washington, DC 20240

Dear Sir:

The following comments are submitted by the Offshore Operators Committee (OOC) on the "Draft Environmental Statement, Proposed 1976 Outer Continental Shelf Oil & Gas Lease Sale Offshore Mid-Atlantic States - OCS Sale No. 40".

In general, it is our opinion that the Statement is satisfactory, although it consistently tends to overstate the negative aspects of offshore operations, in some instances with unsupported conclusions. Most of these issues were addressed by the American Petroleum Institute panelists and/or other industry spokesmen at the Public Hearing in Atlantic City, N.J., and will not be repeated in our comments. We wish to concentrate on the various discussions of overboard discharges.

There are inconsistencies between the Draft Environmental Statement and the Proposed Mid-Atlantic OCS Order No. 7 and the EPA effluent guidelines for offshore oil and gas extraction operations which were published in the FEDERAL REGISTER on September 15, 1975. Our specific comments are:

1. Drilling Muds - The following statements are typical of those contained in the Draft Statement concerning the discharge of drilling muds: "Drilling muds are not directly discharged into the ocean" (Volume 2, page 70), "In this case since discharge is not allowed without a permit under the proposed OCS operating orders, approval for ocean disposal would have to be obtained from both the USGS Supervisor and EPA" (Volume 2, page 152) and "No direct ocean disposal of drilling muds will be allowed in the Mid-Atlantic and any request for variance must be reviewed on a case-by-case basis" (Volume 2, page 320).

   It is routine and accepted practice in the Gulf of Mexico to discharge muds overboard as required during various phases of the drilling operation. The demonstrated environmental impact of such discharges is negligible.* Accordingly, such discharges are allowed by the existing OCS Order No. 7 and will be allowed to continue under the proposed revision published in the FEDERAL REGISTER on December 10, 1975. This proposal contains the stipulation: "Drilling mud containing oil shall not be disposed of into ocean." Further, the published EPA effluent guidelines also allow such discharges with the condition that there be "no discharge of free oil". (The OOC has recommended that the Order No. 7 statement be modified to read "Drilling mud containing free oil shall not be disposed of into the ocean" for reasons of clarity and consistency with the EPA guidelines.)

---

*In this regard the Offshore Operators Committee is presently preparing a report titled "Environmental Aspects of Drilling Muds & Cuttings from Oil & Gas Extraction Operations in Offshore & Coastal Waters" which documents and summarizes the available scientific literature and supports this statement. A copy will be furnished to the BLM as soon as the report is completed. - Currently it is anticipated that this will be in March.

Therefore, since the statements in the Draft Environmental Statement are erroneous, the OOC recommends that they be corrected in the Final Environmental Statement.

2. Drill Cuttings - The following statement is made in Volume 2 on page 71: "Once separated from these muds, the cuttings will be washed to remove excess oil if oil concentrations are greater than 48 ppm." Other similar statements are scattered throughout the report. This is in direct conflict with the proposed Order No. 7 and the EPA guidelines. The requirements under both of these is for "no discharge of free oil". The OOC recommends that the Final Environmental Statement be corrected to eliminate these errors.

3. Produced Water - On pages 68-69 the following is stated: "The EPA standards promulgated for 1983 set this level at 30 ppm (Section III.A.1.c.). Experience indicates that this standard is attainable." While the EPA effluent guidelines published on September 15, 1975 do contain such a standard, the OOC does not believe that experience indicates it to be attainable. We have recommended to the EPA that the standard be modified to 48 mg/l. (A complete copy of our comments to the Agency on this and other matters dealing with the effluent guidelines are attached for your information.) We recommend that the sentence "Experience indicates that this standard is attainable," be removed from the Final Environmental Statement.

4. Sanitary Wastes - The statement "EPA regulations require that the effluent contain 50 ppm or less of biochemical oxygen demand (BOD), 150 ppm or less of suspended solids, and have a minimum chloride residual of 1.0 mg/l after a minimum retention time of fifteen minutes." (Volume 2, pages 15 & 16) is incorrect. Similar erroneous statements are also made elsewhere in the document. The EPA guidelines published on September 15, 1975 state that for sanitray waste sources from facilities serving continuously 10 or more persons the parameter controlled shall be residual chlorine and it shall be a "minimum of 1 mg/l and maintained as close to this concentration as possible". For intermittently manned facilities and those serving continuously nine or less persons, the criteria is "There shall be no floating solids as a result of the

discharge of these wastes". The OOC recommends that the Draft Environmental Statement be revised to correct these errors.

The Offshore Operators Committee appreciates the opportunity to make these comments. As you are aware, the OOC has cooperated with the Bureau of Land Management in the past by furnishing considerable information for use in preparing various impact statements, including the one for proposed Sale No. 40. Please advise if you believe we can be of additional assistance.

Yours very truly,

C E Golay
C. E. Golay
Chairman

Attachments

cc - (Information Copy w/attachments)
Mr. Frank M. Basile, Manager
New York Outer Continental Shelf Office
Bureau of Land Management
6 World Trade Center, Room 600D
New York, New York 10048

Mr. John Rankin, Manager
Outer Continental Shelf Office
Bureau of Land Management
1001 Howard Avenue, Suite 3200
New Orleans, Louisiana 70113

Mr. Allen Cywin, Director
Effluent Guidelines Division
U.S. Environmental Protection Agency
Waterside Mall
401 M Street, S.W.
Washington, DC 20460

Dr. V. E. McKelvey, Director
U.S. Geological Survey
National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

MARINE SCIENCES CENTER • NEW BRUNSWICK • NEW JERSEY 08903 • 201/932-3080

February 10, 1976

Director
Bureau of Land Management
Washington, D.C. 20240

Dear Sir:

I submit this written statement as a comment on the "Draft Environmental Statement" concerning the proposed Mid-Atlantic Lease Sale #40. I trust you will give these statements as much value as those presented at the hearing in Atlantic City.

Sincerely,

Dr. Norbert P. Psuty
Director

NPP:dw
Enc.

RECEIVED
FEB 13 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

Statement on the Hearings on the Draft Environmental Statement on Proposal 1976 Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States OCS Sale No. 40

February 9, 1976

Norbert P. Psuty
J. Kenneth Mitchell
Lorraine Caruso
Harold Haskin

This statement is presented by a group of concerned faculty and staff from Rutgers University but it does not represent the attitude of the University. Instead, we present this critical evaluation to draw attention to several important aspects of offshore development that have been omitted from the environmental statement or are misrepresented in the environmental statement. Although we realize that the production of the "draft" is a monumental task that would probably always fall short in some aspect, we feel obliged to point out that the present version has inadequacies that require additional research effort.

Whereas the draft statement indicates that a small amount of the coastal resources of coastal New Jersey would have to be committed to irreversible change because of development, there is state legislation that protects the biologic community referred to as the "tidal wetlands." Given our action to preserve the wetlands, no refineries, tank farms, or terminal facilities should be permitted within this portion of the state. Further, a survey we conducted of the refineries indicates that present facilities are capable of handling the offshore production and thus there should be no need to disturb our diminishing wetlands.

Our major marine industry in value is the harvesting and processing of the surf clams that occupy a position in the offshore zone. Some of the area fringes on the proposed lease grounds and there is a potential for conflict between harvesting the clam and petroleum exploration and production. The surf clam industry provides about 45-50 million dollars of income on a continuing basis to the state's citizens when the processing is included. At present, the industry is going through a mild revival because the beds off Maryland and Virginia have been over-exploited. New regulations are currently being established to maintain production in the New Jersey area and interference with the harvesting because of contamination or incompatibility of harvesting technique with rigs or pipelines would pose a serious handicap to the clammers and the clam industry.

The shellfishing in the nearshore and estuarine waters could also come into conflict with the proposed changes in land use. The Federal Water Pollution Control Act has established that the shellfish harvesting and growing waters shall remain in their current use. If any of the onshore developments would negate this use, then there is reason to move against the development. Further, despite the guarantees by the industry to maintain high environmental quality for the inshore waters, it would be of value to enforce the clean-up of the existing problem areas as a measure of credibility rather than permit the present poor conditions around the refineries to persist.

Beyond the establishment of strong standards based on parameters grounded in fact is the necessity for a careful monitoring of point sources of pollution via the NPDES permitting system. Refineries must comply with NPDES procedures, monitor their effluents, and subject this monitoring to the scrutiny and guidance of EPA and DEP officials. Their full cooperation would lessen the impact and embarrassment of enforcement actions against violations of regulations. Using 301e and 302 "escape clauses" in the Federal Water Pollution Control Act to attempt to evade compliance with seeking "best available technology" or from the explicit goals of the Act, causes the citizens and the regulating agencies to doubt the seriousness of the statements coming from the oil industry concerning the industry's spill avoidance techniques and ability to handle spills.

We have established a high priority for protecting coastal resources in New Jersey, the Division of Water Resources has proposed a water pollution control program for 1975-1976 that assigns highest priority to two geographic segments of the state: the freshwater Passaic River and the northern coastal waters. The basis for the high priority rating is: 1) the great quantity of people in the area; 2) the poor water quality in a portion of the system; and 3) the need for the preservation of high water quality. The need for water supply, aquatic food resources, and recreation places both of the areas in an intensive use category.

A bay and ocean water quality monitoring program has just passed through the planning stages for coastal New Jersey. We applaud the identification of 25 bay and 17 ocean supplying stations and see the information collected as the beginning of the necessary data base that will establish the water quality requirements for fish and shellfish waters. There will have to be a number of similar programs created before we can effectively deal with the problems of onshore impact in a quantitative sense.

The estimates of employment, infrastructure requirements, and new land use demands seem to underestimate the requirement of OCS development. The statement omits consideration of possible employment related to the manufacture, fabrication, and emplacement of offshore pipelines. It is highly likely that, at a minimum, a pipecoating plant will be required to provide and install concrete ballast jackets for the steel pipe. A pipe fabrication plant close to the anticipated pipeline landfall is also probable. Several hundred jobs would be directly generated by these facilities. Of even greater significance is the omission of potential employment in steel platform fabrication yards. Some platforms can be supplied from Gulf Coast yards but (1) the large number of platforms which may be required(up to 50), and (2) the interest shown by platform fabricators in constructing east coast yards, both suggest that some platform building will occur within the mid-Atlantic region. Such developments are labor intensive and could well generate several thousand jobs. Even without the addition of a new oil refinery, the platform and pipeline industries could provide, through the multiplier effect, enough extra regional employment to at least double the BLM estimates of 4,200 to 15,400 new jobs (p. 179). Furthermore, most of these additional jobs would be localized close to the shore zone.

The significance of the additional employment is the demands on the coastal zone. There appears to be some discrepancy between data in (i) Table 1-1 ("Acreage and Facilities and Activities Expected to be Required to Develop Hydrocarbon Resources Within the Proposed Sale Area", p. 16, Vol. 1);

(ii) Table III-27 ("Industry Estimates of Onshore Facility Requirements for OCS Oil and Gas Operations in the Baltimore Canyon", p. 173, Vol. 2); (iii) Table III-28 ("Estimated Land Use Requirements of OCS-Related Facilities", p. 219, Vol. 2), and (iv) the statement that "... a total of 160 to 645 acres would be required region-wide for OCS-related facility development", (p. 220, Vol. 2). Close inspection of these tables indicates that the estimated demands for land acreage given in the statement are considerably too low. The BLM's estimate of land requirements is even more misleading because the amount of land needed in relation to the secondary impacts of OCS development has not been included, and if pipecoating and platform construction industries develop within the region, additional land - perhaps totaling at least 1,000 acres - would be required. Much of this would be on waterfront sites.

An important aspect that has not been adequately covered is the accumulative effects of the petroleum-related stresses and the existing environmental stresses. In most cases, the natural systems are undergoing degradation that requires immediate correction. Further development would only aggravate an existing situation that is pollution-ridden. Given the flood-prone and hazardous locations that are being presented for the new development, we wonder whether there has been any serious thought given to the additional stresses created by the petroleum development.

The section on mitigating actions for onshore facilities (Vol. 2) is inadequate. It describes the types of formal regulatory mechanisms which presently exist rather than discussing specific measures which can, or should, be taken to cope with onshore problems. The existence of a permit program, for example, is not evidence that such a program would, in fact, act as a mitigating factor. This type of approach merely "passes the buck" to other administrative agencies and obscures real issues. We need information on the precise nature and quality of the potential and actual ranges of mitigating measures.

The test that should be put to the companies that make the great claim for safety, environmental preservation, and public concern is one of proof by application to the present facilities. If the technology exists to build a "clean" refinery, then apply it to the existing plants. If the concern for the environment is real, then display it in the present operations.

If the exploration proceeds, care must be exercised not to over-commit our existing natural resources. Our natural coastal zone is reusable and most of the existing extractive industries are working with biologic resources that are self-reproducing. A major oil spill, contamination of an inshore or estuarine system, or polluted water bodies would have a long-lasting effect on the harvesting from our coastal zone and on its use. It must be remembered that we do not enjoy the best reputation for maintaining a pristine environment in New Jersey and further development will probably be perceived as further environmental degradation. If this perception leads to decreased use of our coastal zone by the tourist and recreational industries, we would have a major reduction in our second leading income-generating industry in our state. The key to this industry is the perceived environment and we should constantly strive to improve both the real and the perceived environmental quality in coastal New Jersey.

MIDDLESEX COUNTY PLANNING BOARD

40 LIVINGSTON AVENUE
NEW BRUNSWICK, NEW JERSEY 08901
(201) 246-6062

MEMBERS
HYMAN CENTER, Chairman
SIDNEY SEWITCH, Vice Chairman
JOHN BERNAT, JR.
PETER DALY CAMPBELL, Freeholder Director
STEPHEN CAPESTRO, Freeholder
NANCY THOMAS DURANT
JOHN J. REISER, JR., County Engineer
LAURENCE S. WEISS
WALTER L. WILSON

DOUGLAS S. POWELL
Director of County Planning

FRANK J. RUBIN
Counsel

PATRICIA A. LYCOSKY
Secretary

February 11, 1976

Office of the Manager
New York Outer Continental Shelf Office
Bureau of Land Management
Six World Trade Center, Suite 600D
New York, New York 10048

Re: Draft Environmental Statement;
OCS Sale No. 40

Dear Sir:

The enclosed statement relative to the Draft Environmental Statement - Proposed 1976 Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States (OCS Sale No. 40) was approved for transmittal by the Middlesex County Planning Board at their meeting of February 10, 1976 and is being transmitted to you for inclusion in the public record.

The Board notes that our review and comments do not address all of the issues and impacts contained in the draft environmental statement, however, the review does express concern regarding the inadequacies of the basic assumptions upon which the potential onshore impacts which may affect Middlesex County are developed and analyzed. In urging that the issues raised in this review be addressed in the preparation of the final environmental impact statement, the Board further notes that the Federal Coastal Zone Management Act, in which all of Middlesex County is included, mandates that comprehensive planning be carried out within the CZM area. The draft E.I.S., with the flaws and omissions which distort the analysis of potential onshore impacts, fails to fulfill the legal obligations of the National Environmental Policy Act and contrivenes the intent of the Coastal Zone Management Act.

The Middlesex County Planning Board appreciates this opportunity to review and comment on this draft E.I.S. and looks forward to reviewing the responses prepared by the Department of the Interior. The Planning Board staff is available to further discuss the contents of this review at your request.

Sincerely yours,

MIDDLESEX COUNTY PLANNING BOARD

DS Powell

DOUGLAS S. POWELL
Director of County Planning

DSP:iws
Enclosure
cc: Mr. Curtis J. Burkland, Director, Bureau of Land Management

STATEMENT TO THE NEW YORK OUTER CONTINENTAL SHELF OFFICE, BUREAU OF LAND MANAGEMENT REGARDING THE DRAFT ENVIRONMENTAL STATEMENT - PROPOSED 1976 OUTER CONTINENTAL SHELF OIL AND GAS LEASE SALE OFFSHORE THE MID-ATLANTIC STATES

(OCS SALE NO. 40)

Prepared by
Middlesex County Planning Board
New Brunswick, NJ
February 10, 1976

Introduction

This statement constitutes the Middlesex County Planning Board's review and comments for inclusion in the public records regarding the Draft Environmental Statement for the Proposed 1976 Outer Continental Shelf Oil and Gas Lease Sale Offshore The Mid-Atlantic States (OCS Sale No. 40). The Board appreciates this opportunity to review and comment on the Statement because of our deep concern over the interest of the Federal government to move forward rapidly in leasing and developing the apparently promising resources on portions of the Atlantic Coast outer continental shelf.

The Middlesex County Planning Board recognizes that political and economic pressure is rapidly growing in support of exploration for and development of offshore oil and gas reserves and that the nation as a whole needs to develop those supplies of oil and gas which may be found in areas off New Jersey. However, the Planning Board has reviewed, in addition to the present Draft Environmental Statement, many documents prepared by government agencies and consultants regarding the potential impacts of offshore activities and these reviews have indicated that New Jersey, and Middlesex County in particular, can anticipate substantial additional growth beyond that which would normally be expected to occur and from which substantial environmental degradation is a potential result.

Given its location on Raritan Bay and the Arthur Kill, the considerable distance to the northern most tract to be leased, and the direction of the prevailing surface currents (as shown on

Visual #2), Middlesex County will probably not receive direct (primary) environmental impacts from offshore drilling operations or from such occurances as the landfall of oil spills. Therefore the Planning Board, in its review of the Draft Environmental Statement, is primarily concerned with the more significant secondary (onshore) impacts of this development which can be anticipated within, or affecting, Middlesex County.

Background and Assumptions

Substantial portions of the information and discussion contained in the Draft Environmental Statement for the proposed OCS Sale No. 40 were drawn from previous and companion studies developed relative to OCS development including:

(1) "OCS Oil and Gas - An Environmental Assessment" A report to the President by the Council on Environmental Quality, April 1974.

(2) "Draft Environmental Statement Proposed Increase In Acreage To Be Offered For Oil and Gas Leasing On The Outer Continental Shelf" (DES 74-90), prepared by the Bureau of Land Management

(3) Final Environmental Statement relative to (2) above.

(4) "Economic Study of the Possible Impacts of a potential Baltimore Canyon Sale" Technical Paper No. 1, Bureau of Land Management, December 1975.

In its review of previously prepared documents and statements relative to OCS development, the Middlesex County Planning Board has consistently questioned the set of assumptions used as a basis for projecting the potential economic, social and environmental impacts. The Draft Environmental Statement for OCS Sale No. 40, based on those previous documents, continues to utilize the basic assumptions criticized by the Board in its previous reviews. The draft E.I.S. differs from Interior's previous statements only in that if attempts to analyze the site specific OCS Sale No. 40 as opposed to an analysis of total OCS development.

The Middlesex County Planning Board has identified two major and basic assumptions contained in the draft statement which substantially affect the magnitude of the onshore impacts projected by the statement. The first of these is the assumption that crude oil produced as a result of OCS development will replace, barrel for barrel, the crude oil presently imported to this region from foreign sources. The second is the assumption that operations bases, pipeline land terminals or combinations of the two will be located in only four New Jersey coastal counties (Atlantic, Cape May, Ocean and Monmouth) to the exclusion of other potentially impacted coastal counties in the State.

Areas of Concern

The "areas of concern" of the Middlesex County Planning Board are directly related to, and emerge as a result of the two basic assumptions, outlined above, upon which the draft statement is founded and from which its analysis is drawn. These areas of concern will be detailed and discussed separately in the following section of the review.

(1) Barrel for Barrel Replacement of Foreign Crude

The draft environmental statement, in Volume 2, page 180, states:

> "Production of oil from the proposed Baltimore Canyon sale can be expected to flow to existing refineries located within the area. Imported oil now being used in these refineries can be expected to be replaced by OCS production. It is felt that new refineries will not be built as a direct result of production that may stem from the leasing area." –

However, the statement precedes in the same section (page 181) to contradict this statement relative to the substitution of OCS crude for foreign crude by continuing:

> "It is acknowledged that the quality of crude oil to be found in the Baltimore Canyon may preclude the substitution of all foreign sources of crude reaching the Mid-Atlantic coastal region's refineries."

In elaborating on the above statement, the report gives as example the case of the asphaltic crude which is imported from Venezuela which would not be replaced by a non-asphaltic crude which may be found in the Baltimore Canyon OCS lease area. The draft statement however does not discuss what percentage of the current consumer demand or refinery capacity is committed to the processing of this or other non-replaceable types of foreign crude. This omission leaves open the question of how much refinery capacity is actually available for the processing of OCS crude as a substitute for replaceable foreign crude.

There is a more basic element of the assumption of barrel for barrel replacement of crude oil supplies which is totally omitted from the draft statement. There currently exists a wide divergence of opinion among both economists and oil industry representatives relative to this country's future dependence on the importation of foreign oil supplies. The replacement of foreign crude oil supplies with OCS crude with no substantial increase in refining capacity, would meet the requirements of consumer demand only if that demand were to be held steady (i.e. no increase in per capita demand). However, with no effective method for regulating consumer demand, this region's (and the nation's) per capita demand for oil, and oil related products, will continue to increase as evidenced by past trends and current economic/industrial projections. The draft statement does not fully explore the market dynamics which influence refinery and industry activities, nor does it discuss any administrative or legal mechanisms which might be utilized to circumvent market dynamics and insure that the replacement of foreign crude supplies with OCS crude will in fact take place.

By understanding the potential demand for increased refinery capacity, either through expansion of existing capacity or through the construction of new refineries, the draft statement does not explore the economic, social or environmental impacts which would result through the expansion of refinery capacity in the Mid-Atlantic region in general and in the State of New Jersey in particular. The assumption that OCS crude supplies will be used to supplant foreign crude is not sufficiently developed, supported or analyzed in the statement to allow that assumption to be used as (1) a basis for neglecting a review of the impacts associated with increased refining capacity or, (2) a basis for projecting future levels of development and economic activity and the potential resultant impacts.

(2) Locational Characteristics of On-Shore Development

The discussions of onshore impacts in the draft statement are predicted on the assumptions developed in the econometric study (Technical Paper #1) which projects that onshore operations bases, pipeline land terminals or a combination of both will be constructed in Atlantic, Cape May, Monmouth and Ocean Counties in New Jersey and in Kings County, New York. The statement, however, does not develop an adequate factual or statistical basis upon which this assumption can be supported. In addition, the E.I.S. proceeds from a rather gross range of total regional (Mid-Atlantic) employment and population estimates (Direct OCS employment for 1980: 900-3,600; induced employment: 4,200-15,400; induced population 5,600-20,800) to an unfounded quantification of onshore development distribution in a very limited portion of the Mid-Atlantic region.

There currently exists no administrative or legal mechanism to insure that the onshore development which may result from the exploration for, and development of OCS oil and gas resources will be as widely distributed, both in location and time of construction, throughout the coastal counties in New Jersey as is hypothocised in the E.I.S. On the contrary, there currently exists in the State of New Jersey's "Coastal Area Facility Review Act" regulatory and review authority directed at the types of development projected by the draft statement. In addition, it must be noted that substantial portions of the four coastal counties of New Jersey identified in the statement fall within the legislated CAFRA area and will therefore receive some measure of "protection" from indiscriminate development resulting from the proposed lease sale. However, only a very small portion of Middlesex County, which is mostly in State ownership or protected by the State Wetlands Act, has been included in, and afforded the protection of the Coastal Area Facility Review Act. The potential exists therefore that the additional development resulting from the proposed lease sale will be directed away from those more restricted locations within the CAFRA area and toward those areas which are not included in any legislated, regional or areawide developmental controls such as Middlesex County.

In addition to the legislative controls affecting development in the four New Jersey coastal counties identified in the draft statement, there are socio-economic parameters affecting locational decisions for onshore development which have not received sufficient analysis in the E.I.S. Even a cursory examination of economic base analysis and input-output analysis raises serious questions as to why Middlesex County, with its existing base of industrial development, transportation infrastructure, labor market, available land, and public service infrastructure (water, sewer, etc.), was excluded from the potential development scenario utilized in the draft statement for its analysis of onshore impacts.

It is recognized that wide dispersion of onshore development, as suggested in the E.I.S., may tend to minimize the effects of direct local impact. However, the "economy of scale" concept and existing development trends raise questions as to whether or not this scenario is the pattern of development which will actually occur recognizing the lack of administrative and legal mechanisms to enforce that pattern in the southern New Jersey Counties. Market dynamics, as well as existing CAFRA regulations may tend in fact to disrupt the assumed development scenario. The draft environmental statement should identify and analyze various other potential development scenarios for their social, economic and environmental impacts on the Mid-Atlantic region in general and Middlesex County in particular. The range of potential onshore impacts which could result from the implementation of the proposed course of action is obscured in the draft statement by its neglect of alternative development scenarios and their attendant impacts on the human environment.

Conclusion

As indicated in the introduction to this review, the Middlesex County Planning Board recognizes that political and economic pressure is growing in support of the exploration for, and development of oil and gas resources and that the nation and the region need to develop those resources which may be found on the outer continental shelf offshore New Jersey. The Board also recognizes that the onshore development resulting from the exploration for, and development of OCS oil and gas reserves may have a substantial and detrimental impact on the human environment of Middlesex County if proper long and short range planning does not precede and accompany the implementation of OCS development.

The Middlesex County Planning Board maintains that a detailed and comprehensive data base and analysis is required as a foundation for planning for the future of the County. The Federal government, in the National Environmental Policy Act (NEPA), also recognizes this requirement for the development of comprehensive data and analysis (in the form of an Environmental Impact Statement) prior to the implementation of any action affecting the quality of the human environment. The Draft Environmental Statement for the proposed OCS Sale No. 40 does not adequately address the concerns of NEPA or the Middlesex County Planning Board with regard to the development of pertinent data and analysis upon which a judgement of the affects of the proposed action on the human environment can be drawn. This failure of the E.I.S. negates the possibility for orderly and environmentally sound, comprehensive planning for the potential impacts of the proposed action.

The preparation of the draft E.I.S. was hindered by the uncertainty relative to the amount of recoverable resources existing on the outer continental shelf (oil: 0.4 billon barrels - 2.6 billon barrels; gas: 2.6 trillon cubic feet - 12.8 trillon cubic feet). This uncertainty was reflected in the extremely wide range of related projections contained in the draft statement. For example:

Number of Offshore Platforms = 10 - 50
Miles of Pipeline = 50 - 570
Number of Gas Processing Plants = 3 - 8
Production = 90,000 - 750,000 Barrels/Day
Regional Employment (thousands) = 4.20 - 15.40
Regional Population (thousands) = 5.60 - 20.80

These ranges (population, employment, production, etc.) do not establish a sufficient basis upon which to formulate an analysis of the potential impacts of this activity. In order to adequately project the levels of population, employment and onshore resources required, further refinement of the amounts of recoverable resources will be required. However, that portion of the E.I.S. dealing with alternatives to the proposed action does not adequately evaluate alternative means of quantifying the estimates of recoverable resources prior to the development of these resources. The NEPA guidelines require that the E.I.S. fully analyze such alternatives prior to their rejection.

Finally, the utilization of unfounded assumptions regarding crude oil through-put (barrel for barrel replacement of foreign crude) and onshore development locations distorts the analysis of potential impacts related to OCS exploration and development. An accurate and systematic analysis of the impacts related to the proposed action can be accomplished only when that analysis is developed from reasoned assumptions.

The Middlesex County Planning Board urges the Department of the Interior to respond to the issues raised in this review prior to the time that the draft statement becomes final and the proposed course of action is implemented.

JOHN H. McDERMITT
COUNSELLOR AT LAW
140 MARKET STREET
PATERSON, NEW JERSEY 07505
(201) 279-7600

February 11, 1976

Department of Interior
Bureau of Land Management
New York OCS Office
6 World Trade Center, Suite 600 D
New York, New York 10048

Re: Draft Environmental Statement
re OCS sale no. 40

Gentlemen:

As a citizen of the United States and a resident of the State of New Jersey I have read with such talents as I can bring to bear, volumes 1 and 2 of the Draft Environmental Statement and the visuals which compose volume 3.

In reviewing the visuals I respectfully advise you that visual number 1 fails to reflect the acquisition of several thousand acres of the waters, marshes and islands on the north shore of Great Bay (opposite the Brigantine National Wildlife Refuge) by the State of New Jersey as park land. Table 2-70 insofar as it represents shore line frontage is not impacted by this acquisition. However, it does point up the failure of Table 2-70, at least so far as it effects New Jersey, to adequately weigh in the estuarine shoreline of the State, particularly in the area south of Sandy Hook and running around to the out fall of Racoon Creek into Delaware Bay.

Visual 5 is false in designating all of Delaware Bay as "major harbor area" which is the showing on that visual. Very extensive areas of the Jersey side of Delaware Bay are so shallow as not to be usable by ocean going vessels. These areas are, in fact, the basis of a very extensive shell fishing industry. This shell fishing is vital to the economic and social life of the area and has been so and has been supported by the State of New Jersey for over 150 years. Especially since the visuals are a relatively simple matter to study and understand as against the over 1300 pages of material in the other two volumes of the Environmental Statement, it seems to me most consequential.

Those portions of the statement dealing with pipe lines seem to me to be seriously deficient. Page 85 and 86 of Volume 1 advert to the possibilities of slumping and subsidance. Page 15 of Volume 1 indicates that gathering lines would connect to large diameter pipe lines which would carry the production to shore. The very idea that large diameter pipe lines should be installed in such underwater lands as are shown on Visual No. 3 and particularly largely in sands, without independent rigid support is so utterly wrong as to begger description. Only the worst kind of selfish interest in the oil produced from off shore wells could possibly even consider setting large diameter pipe lines in such soil without independent support resting on stable subsoil so deep as to be impervious to scour. To anyone familiar with the quantities of sand which can be moved by the Atlantic Ocean in this area during periods of storm, it would appear to be an absolute violation of the Public Trust for any governmental body or officer to permit such installation.

A further very serious deficiency in the Statement as a whole, is its failure to consider the actions which are under way by the States to establish alternate sources of energy in the near vicinity of the areas proposed to be leased. I have reference to the existing nuclear power energy plant of The Jersey Central Power & Light Company at Oyster Creek in Ocean County and the proposed nuclear power plant which Public Service Electric & Gas Company has projected at Little Egg Harbor Inlet in the waters three miles off shore. This lies in Atlantic County. Public Service's plans are well advanced and have received the approval of the Nuclear Regulatory Commission. Farther down the road, Public Service proposes that if the Little Egg Harbor Plant is a successful construct then it would seek to construct one within three miles of the Barnegat Inlet in Ocean County some time down the road. Your Visual No. 2 should indicate to any rational person that this constitutes no small danger to the existence and use of off shore drilling platforms. The wind roses on No. 2 do not accurately reflect the persistent strong Southwesterly air flow characteristic of the Jersey shore. The elementary disaster of explosion at any such plant should not be augmented by construction of pipe lines or drilling platforms without serious consideration being given by your Bureau to the dangers involved. Page 32 et seq in Volume I deals with the State of New Jersey's Coastal Area Facility Review Act. While I can understand that the Coastal Zone Management legislation at the Federal level blankets the jurisdiction in question, yet I believe that any reasoned consideration of the propriety of leasing areas on the outer continental shelf should also consider other applicable statutes. I don't know what they would be in other States, but I refer you to New Jersey Statutes 13: 1B-1 et seq, 13: 9A-1 et seq, 13: 17-1, and 13: 18-1. The latter three of these Acts set up separate jurisdictions and authorities from the jurisdiction imposed in the State by CAFRA.

I respectfully suggest further that the Bureau of Land Management as well as the Environmental Protection Agency and the Federal Energy Authorities should re-consider the need for the leasing of outer continental shelf lands for exploration and production of oil. The recent disclosure of the very serious conflicts between private industry's forecast of "known reserves" and the National Geological Survey's estimate of the same shows differences in these estimates which are sufficient in my mind to warrant a re-consideration of the entire concept of exploiting the off shore oil potential in the mid-Atlantic area. At least the statistics should be re-evaluated on the basis of some rational system for determining whether or not "known reserves" are, in fact, dwindling. It appears that the private industry's statistics are based on and impacted directly in substantial measure by the monies invested by private industry in exploration. Clearly both reason and the public interest dictates that, in order to work out an accurate picture of the discovery rate of "known reserves" the ratio of exploratory drilling footage to successful production well drilling footage be used. If the economics of corporate profits inhibit the intensity of private exploration, then the Government should do it, cost be damned. Sale of "known reserves", novel as the idea may be to your Department, would certainly yield a large part of exploratory costs. It has to private industry until recent years.

Respectfully yours,

John H. McDermitt

JHM/af

John H. McDermitt

Natural Resources Defense Council, Inc.

15 WEST 44TH STREET
NEW YORK, N.Y. 10036
212 869-0150

Washington Office
917 15TH STREET, N.W.
WASHINGTON, D.C. 20005
202 737-5000

Western Office
664 HAMILTON AVENUE
PALO ALTO, CALIF. 94301
415 327-1080

BOARD OF TRUSTEES
Stephen P. Duggan
Chairman
James Marshall
Vice Chairman
Dr. George M. Woodwell
Vice Chairman
Dr. Dean E. Abrahamson
Mrs. Louis Auchincloss
Boris I. Bittker
Frederick A. Collins, Jr.
Dr. Rene J. Dubos
James B. Frankel
Robert W. Gilmore
Lady Jackson, D.B.E.
Hamilton Kean
Dr. Joshua Lederberg
Anthony Mazzocchi
Paul N. McCloskey, Jr.
Michael McIntosh
Eleanor Holmes Norton
Owen Olpin
Franklin E. Parker
Dr. Gifford B. Pinchot
Charles B. Rangel
Robert Redford
John R. Robinson
Laurance Rockefeller
J. Willard Roosevelt
Whitney North Seymour, Jr.
David Sive

Beatrice Abbott Duggan
U.N. Representative
John H. Adams
Executive Director

COMMENTS OF THE
NATURAL RESOURCES DEFENSE COUNCIL, INC.,
ON BUREAU OF LAND MANAGEMENT'S
DRAFT ENVIRONMENTAL STATEMENT
ON PROPOSED OIL & GAS LEASE

SALE #40

OFFSHORE THE MID-ATLANTIC STATES

A. KARIM AHMED, Ph.D.
FRANCES BEINECKE, M.F.S.
SARAH CHASIS, ESQ.
TANYA ROBERTS, CONSULTANT ECONOMIST

Natural Resources Defense Council

February 17, 1976

73
100% Recycled Paper

Introduction

The Natural Resources Defense Council (NRDC) is a non-profit membership organization dedicated to protecting America's endangered natural resources and improving the quality of the human environment. NRDC has a national membership of over 18,000. Of these, 6,000 live in those Mid-Atlantic states which could be affected by the Proposed Oil & Gas Lease Sale No. 40. NRDC has followed the development of the federal accelerated leasing program since its inception in 1974. In that connection, we have submitted comments on the Programmatic Environmental Statement and the site-specific statement for the proposed Alaskan lease sale. In our present review of the Draft Environmental Statement on OCS Sale No. 40 (hereafter "DES"), we have found the document to be seriously deficient in a number of important respects. The DES fails to satisfy the requirement of a detailed statement as required by §102(2)(C) of NEPA. Many key impacts are not considered and secondary or indirect effects go undisclosed. Critical assumptions affecting predictions of impacts are made without basis or justification. Many of the subjects disclosed are treated in an unanalytic, superficial fashion. Insufficient information is provided on the Environmental Studies Program; onshore impacts of the proposal are grossly understated and possible impacts ignored. The evaluation of cumulative impacts is misleading.

Many of the inadequacies of the environmental statement flow in large measure from the inadequacies inherent in the proposed leasing program itself. The constant references to lack of information and data regarding the vital natural resources impacted is indicative of the very heart of the problem. If the Department of the Interior is to obey the mandate of the Outer Continental Shelf Lands Act to regulate OCS oil and gas operations so as to prevent waste and conserve natural resources and the clear Congressional intent as expressed in the Federal Coastal Zone Management Act that this nation's coastal resources be preserved and protected, the leasing program cannot go forward as proposed. The leasing must follow comprehensive and meaningful environmental review undertaken upon the completion of background studies of the natural resources affected. Additionally, it must follow improved inspection and regulation of leasing operations; improvement in and testing of safety and environmental control technology, including spill control technology, to reduce the possibility and effects of oil spills; completion by states of coastal zone Management programs.

The format these comments follow tracks that of the DES for purposes of clarity and convenience.

I. DESCRIPTION OF THE PROPOSAL

I.D. 1 Activities Resulting from the Proposed Sale

The DES estimates the magnitude of the proposed Mid-Atlantic sale.* It is worthwhile to compare the actual figures of the Southern California sale with those estimated for the proposed Mid-Atlantic sale. In Southern California the oil companies bid on less than 1/3 of the 1800 square miles of offered tracts. Thirty-six of the 231 tracts were bid on. The total amount for the bids came in at $438 million.** Secretary of the Interior Thomas Kleppe had estimated that the sale would be $1.5 billion. The actual bids were 26% of the anticipated sum.

The first Mid-Atlantic sale offers 154 tracts, 876,750 acres, for leasing. The DES estimates that 523,756 acres will be leased, or approximately 60% of the offered tracts. In view of the California lease sale experience, we can only regard this estimate of lease sales as probably grossly overstated.

A number of possible conclusions may be drawn from this. The first pertains to the fair market value requirement of the federal leasing program.[*] If the bids are substantially less than those projected by Interior, the federal government may not be receiving what it has determined to be a fair market value for these tracts. Second, it indicates that the benefits predicted to flow from the leasing program may have been greatly overstated. Third, the low bids in California may be an indication that while the oil companies may bid for tracts at this time they do not intend to develop them. Again, this would mean that the benefits to be gained from accelerated leasing now have been greatly overstated.

---

*Vol. I, Table I-1, p. 16.

**N.Y. Times Dec. 12, 1975.

In view of the significance of the questions raised about the benefits of OCS leasing, as a result of the California sale, the Interior Department must revise the DES to include a consideration of these questions.

I.D. 2 Environmental Studies Program

The two paragraph description of the environmental studies program is totally inadequate. No schedules are given indicating when each study is expected to produce usable information. No explanation is given on who is conducting the studies, or what research techniques are being used. There is no indication of whether data on direct or indirect environmental impacts will be gathered in this program.

---

[*] The Outer Continental Shelf Lands Act of 1953, 43 U.S.C. Section 1333(b).

It is impossible to determine if the studies proposed will obtain the baseline environmental data that is presntly lacking for the Baltimore Canyon. For example, the DES admits ignorance as to many areas of critical importance to safe operation, including aquifer formations (raising problems concerned with salt water intrusion) (DES I-81); subsidence potential (DES I-86); geopressures (DES I-88); bottom sediment transport (DES I-91, 94); circulation of slope water (DES I-136); circulation of subsurface and bottom water (DES I-137); phytoplanktonic populations (DES I-212, 222, 223); zooplanktonic relationships with phytoplankton (DES I-230); spawning characteristics of fish (DES I-278, II-80); impact of sublethal oil on fish (DES II-105); life history of commercially significant fish (DES I-426, 453, 455, 457); oil spill trajectories (DES II-52); effects of turbidity and resuspension of toxic minerals due to pipeline laying (DES II-82, 91, 92). The DES does not explain how these gaps in information are expected to be filled, if at all, by the environmental studies program.

The conclusion that "This research program provides information for management decisions" goes unsupported. It is impossible to ascertain how the timing of the management decisions and the availability of the data will be juxtaposed. It is also unclear how data will be used in planning a program once the program has already commenced.

I.F. Relationship to Other Governmental Programs

2.a. Coastal Zone Management: The draft statement's description of the coastal zone management program is cursory in its explanation of how offshore oil facilities and development may be addressed by the CZM programs. One of NRDC's primary concerns with the accelerated leasing program is that onshore impacts and activities will be generated before states have their coastal zone management programs in place. For example, purchases of land for onshore facilities related to development and production may occur before coastal states have coastal zone management programs. Thus, by 1977 when coastal states theoretically will have their management programs in place,* many of the OCS programs' onshore impacts will have been determined.

---

*Legislation presently pending in Congress gives states an additional year for program development, thus possibly extending until 1978 the date for completion of management programs.

The description of New York State's existing program points out that it is only in the beginning stages. It does not point out that there is little likelihood of New York having a coastal plan by 1977, and that many areas, particularly the Hudson River estuary, will possibly not be included, thus limiting the state's preparedness for onshore facilities.

III. A. Basic Assumptions Regarding Causes of Offshore Environmental Impacts of the Proposed Sale

2. Pipelines: Transport of the bulk of Mid-Atlantic oil by pipeline is a goal we applaud, but one which is more difficult of accomplishment than the DES makes clear. It is not known whether it will be possible to lay pipelines since the known and previous attempts to dig trenches in the area have had to be abandoned (DES I-87). Pipeline costs are very high: a generalized estimate is $1 million/mile, a figure which does not differentiate between deep-laying of pipelines and standard burial in water less than 200' deep. In view of the uncertainties and high cost, there must be serious question as to the effectiveness of the special stipulation in which the government may require pipeline transport where "economically feasible." If pipelines are not used, what would be the environmental impacts of tanker traffic? These

must be fully considered.

The DES minimizes the width of the channel needed to bring pipelines ashore through dune, marsh and estuary and thus understates the magnitude of nearshore and onshore impacts associated with pipelines. Channels in Florida are 40 feet wide, not 12 feet wide as the DES suggests will be the case in the Atlantic coast. (Statement by Dr. Shirley Taylor, Florida State University, at CEQ hearings on Atlantic OCS drilling, Jacksonville, October 16-17, 1973.)

Soil instability is rated a "serious" threat to pipeline safety by the DES (DES II-35). The DES acknowledges lack of important information in this area (DES I-91). Dr. Miller, a sediment transport expert, stated that there have been very few successful predictions of the effects of storms on sediment transport in the Mid-Atlantic bight.* Before leasing occurs, it should be determined whether pipelines will be able to withstand the sorts of sediment instability they may be exposed to.

III. B. Impacts on Natural Environment

2.a. Impact on Plankton: The DES fails to assess the existing degree of oil pollution in the Mid-Atlantic;

---

*Statement made at Brookhaven Conference on Effects of Energy-Related Activities on Atlantic OCS, Nov. 11, 1975.

thus there is no full disclosure of the effects OCS development would have on an already stressed environment. The DES does recognize that plankton are very sensitive to the presence of hydrocarbons. It concludes without any factual basis that little more than "localized" effects are to be anticipated if oil is spilled (DES II-81).

The DES is remarkably confident about the non-harmful effects on plankton of the millions of barrels of formation waters that will be discharged due to production. It is expected that as much as 2.6 billion barrels of anoxic, highly salty formation water will be discharged (DES I-17, II-81). Aside from the estimated 22 barrels of oil daily, this means that any plankton in the area of the plume, the size of which is not described, will be threatened. Considering that plankton in coastal areas such as this support, in 1/2 percent of the marine surface, 90% of all marine life, (T. Heyerdahl, "How to Kill an Ocean", Saturday Review 11/29/75, p. 15), impacts on plankton should not be dismissed so cavalierly. The DES' corresponding assessment of effects on fish is simply to assert that no impact is likely, without the pretense of authority cited therefor (DES II-105).

4. Air Quality: The draft statement's discussion of the primary and secondary impacts of offshore oil and gas development is both inaccurate and inadequate.

The first questionable statement concerns the levels and effects of SO_x on the regional environment. The DES states that gas processing plants, a necessary facility resulting from offshore oil and gas development, add nitrogen and sulphur oxides to the air and that the effect of these are odor problems and acid rain "in the area", or "in the immediate vicinity of the gas processing plants" (DES II-279-281). However, one of the known tendencies of sulphur oxides in the air is to cause acid rain far from the emission site of the oxides. The distances travelled can be many hundreds of miles, which would severely affect a region much larger than that addressed in the statement. Furthermore in a recent study recorded in Science the wind patterns of the New York Metropolitan area tend in a northeasterly direction (DES II-283). This tendency could increase levels of SO_x in the heavily populated northeastern corridor. The movement of sulphur oxides and their effect on areas far removed from the emission site is an impact that this impact statement does not adequately discuss.

In addition, the DES states that New York City, as well as other urban areas in the region have levels below the standards for SO_x and thus could be expected to absorb the increases in population and in the industrial and commercial sectors without a noticeable percentage increase in pollutants except in the immediate vicinity of the gas processing plants (DES II-283). It has been shown that New York City has a significant air quality problem resulting from high levels of sulfates which are formed from sources which burn sulfur containing fuel.*

A further inadequacy of this section pertains to its failure to discuss the effects of expanded refinery capacity on regional air quality. According to A. D. Little's study on Deepwater Ports**, the existing 1.5 million barrels per day refinery capacity, not now fully utilized, could be expanded to 2.3 million barrels per day. Such an increase could have a substantial effect on SO_x, CO, HC and particulates.*** Indeed, at meeting at Brookhaven National Laboratories on Offshore Oil Effects, a representative from EPA indicated that the possibility of expanding existing refinery capacities is significantly limited by the ambient air levels at existing refineries in the Mid-Atlantic region. The EPA representative indicated that the existing refineries would have to significantly change their present emissions levels if additional capacity could be expected to meet EPA standards for direct sources.* Since the altered, or increased use of refineries may be one of the significant impacts of the offshore program, the effects on air quality resulting from such expansion must be discussed in this impact statement. At present they are not addressed at all.

---

* Con Edison Environmental Analysis of Special Sulfur Limitations for In-City Generating Stations, January 30, 1976.

** Arthur D. Little, Inc. Potential Onshore Effects of Deepwater Oil Technical-Related Industry, Report to the CEQ.

*** Cracking Down, Oil Refining and Pollution, Council on Economic Priorities, Dec. 1975.

III. C. Impact of Man's Use of the Offshore Environment

1. Ports, Shipping, Navigation: The impacts from offshore oil operations on the Mid-Atlantic ports and shipping patterns will be substantial. The draft statement recognizes some of these impacts, but does not adequately assess the magnitude of those impacts.**

The DES points out that major navigation channels cross 5 of the proposed tracts, and that 26 tracts are in heavy traffic areas. Despite this fact, the DES fails to consider means of mitigating conflicts of uses between OCS development and normal navigation traffic. For example, the statement does not propose a deletion of those tracts from the lease sale, nor suggest an altered traffic route.

---

* Ms. Hamner from U.S. Environmental Protection Agency at Conference on Effects of Energy-Related Activities on Atlantic OCS, Nov. 11, 1975, Brookhaven National Laboratories.

** This discussion refers to Sections II G b, III C.1., IV A 2., IV E 4., and Section V J of the Draft Statement.

The discussion on the amount of traffic increase or decrease is inadequate and misleading. As discussed elsewhere in these comments we question the contention that offshore production will replace imported oil, barrel-for-barrel. As a result, we question the conclusion that tanker traffic will significantly decline in the Mid-Atlantic ports. It may, in fact, increase if use of pipelines proves impractical for some or all tracts. Shipping traffic may also be increased by the servicing of offshore operations. Furthermore, it is likely that offshore oil from the Mid-Atlantic region would be required in other regions of the U.S., and may be transported by tanker. None of these possibilities are discussed nor their impacts considered.

The statement does not adequately address the potential pollution resulting from increased shipping. An OTA study* discusses the pollution problems associated with normal tanker operations, such as tank cleaning, and deballasting, as well as the limited data available on the effects of oil pollution of the marine environment. It is our conclusion from reading this study that the environmental effects of tanker transport are so potentially significant and the amount of available information on the effects of marine pollution so insufficient as to necessitate a delay in the lease sales until more base data on the effects of oil in the marine environment is obtained, and until stipulations on traffic routes, navigation requirements for all OCS related shipping traffic, and tanker construction and operation are formulated.* Furthermore, the statement does not adequately deal with the accidents in navigation and tanker operation regulting from human error. As traffic and structural obstructions increase, the risk of accidents from human error increases substantially.

---

*Oil Transportation by Tankers; An Analysis of Marine Pollution and Safety Measures, July 1975.

2. Commercial and Sports Fisheries: A critique of the draft statement's analysis of the impact of the proposal on the Mid-Atlantic fisheries was only possible after attempting to integrate the information contained in Sections II F.l.d, Biological Communities; II G l.f.; Commercial and Sports Fisheries; III B 2.c., Impact of the Fish; and III C 2, Impact on Commercial and Sports Fisheries.

---

*NRDC, with 6 other environmental groups, has filed a suit against the U.S. Coast Guard to stiffen regulations for this express purpose. N.Y. Times Feb. 3, 1976.

The draft statement's description of the Mid-Atlantic fish species, their characteristics, and the economic return from fishing efforts in Section II appears quite complete. However, the statement makes little or no attempt to integrate this information with the impact discussion in Section III. Nor is the information contained in Section III B 2.c. Impact on the Fish correlated with that in III C 2, Impact on the Fishery.

The discussion of the impact on fish suggests that negative impacts could result from chronic low level pollution, from dredging and filling and from potential toxicity from heavy metals in the drilling muds. The statement does not estimate the amounts of metals which will be released into the environment, nor identify these metals contained in the muds: barium, iron, chromium, and sodium chromate. The potential toxicity of these elements and their effect on fish populations is not discussed. In view of the toxicity of chromium and barium, and the avoidance of their use in the Pacific, what possible justification is there for using them in the Atlantic? (DES II-7). If information is not available in this area, further studies are necessary, and the statement should so indicate.

Chronic low level oil will have a significant impact on the nearshore environment and populations, particularly, in the estuaries, when this program has commenced. The draft statement recognizes it as a problem, but gives minimal information on what these impacts may be. No attempt is made to integrate known information on chronic pollution with the Mid-Atlantic environment or its components such as pelagic and demersal fish, shellfish and their nursery and spawning grounds. This is an area which must be studied in great detail, which the statement passes over.

When one reads the discussion of impact on Commercial and Sports Fisheries (Section III C.2.), there is no integration with the information contained in Section III B 2, discussed above. Chronic low level pollution is not discussed in this section nor in those on the plankton and benthos (DES II-146). As sports fishing is done largely in the nearshore and estuarine environments, this is a gross omission. Furthermore, the loss of natural habitat is not discussed. This includes the loss of wetlands, and marine habitat due to dredging and filling and other construction activities. The statement's theory that fish will disperse and move to other areas (DES I - Section III B 2 a & b), overlooks the species characteristics discussed in Section II G 1. f. Species are not habituated to all open water but require specific temperatures, salinity levels, food types, and currents. The assumption that dispersion will minimize impacts from spills is thus not acceptable.

The spawning characteristics of fish must play a crucial part in the consideration of this action. It cannot be assumed that one season or one area is "better" or "worse" than another as far as oil spill impacts are concerned. At a recent conference on the effects of energy related activities on the Atlantic OCS, Art Kendall, a marine biologist at Sandy Hook, stated that there is "no time or place in the Mid-Atlantic Bight where some fish is not spawning and some larvae developing ... there are no sanctuaries." (Brookhaven National Laboratories, Nov. 11, 1975). Protecting fisheries given their present heavily impacted condition, must be a prime concern. Dr. Henneman, a fisheries expert at the Brookhaven conference, stated that data on what was required to support fish populations is just beginning to be collected, and no conclusions were possible yet in response to demands for information on the OCS.

When describing impacts, the statement only describes experiences in the Gulf of Mexico. Is any information available for other ecosystems? Do studies exist on impacts to fisheries off of Southern California or in the North Sea? The statement does not delineate what kind of information does and does not exist in these areas.

In conclusion, the draft statement provides available information on species and catches in the Mid-Atlantic region. However, the discussion of impacts is not complete, as major types of pollution are not discussed, and as no attempt is made to integrate the information available on species with the probable environmental impacts of the program.

III. D. Onshore Impacts of Oil and Gas Operations

The onshore impacts of the OCS sale are minimized throughout the DES. The tendency is to indicate that impacts will be very localized and minimal. Examples of this include predictions that there will be no additional refinery capacity (II - 181), minimal increases in petrochemical activity (II - 226) and minimal acreage required for new facilities such as gas processing plants (II - 219). These projections bear little resemblance to the projections in the Programmatic EIS which indicated that 21% of available land would be required.* The section on cumulative impacts refers to the impacts resulting from an additional sale, not to the accumulation of the "minimal" impacts described in this draft impact statement.

The impact statement does not attempt to discuss secondary impacts in any detail. If a gas processing plant is sited on a 20-acre site in the Mid-Atlantic region, it will attract additional industries and services. This secondary development and the associated impacts are never discussed. The effects of secondary development will be felt particularly in areas such as Southern New Jersey which are primarily rural at present. It is just in such areas that new facilities are likely to be sited. This is because ambient air levels and EPA standards tend to induce industries to locate outside of presently industrialized areas.

---

* DES on Proposed Increase in Acreage to be Offered for Oil & Gas Leasing on the Outer Continental Shelf, Vol. II at 233.

b. Economic Impacts: A point made throughout the draft statement is that no new refinery capacity will be generated by OCS development. This is based on the assumption that imported oil now being used by existing refineries can be expected to be replaced by OCS production. (DES II-180). This critical assumption is one which is never explained or justified. Although one intent of developing offshore oil is to reduce dependency on imported oil, it does not follow that once a domestic supply is produced, all or even a majority of the imported supply will disappear. It is more logical that demand would increase along with supply, and that a certain amount of oil would continue to be imported. This possibility and its consequences are never discussed. For example, if OCS oil production supplements rather than replaces foreign oil the refinery capacity projections presently made by the BLM in this DES would have to be revised.

It is highly illogical that imported oil would be substantially halted if it were available at a price in competition with the price of developing domestic reserves. The price of foreign oil depends in part on the federal government's pricing policies which are never discussed in the draft statement. Because no formal energy policy has been adopted, it is inconceivable that such a definitive statement concerning replacement of foreign oil by OCS oil could be made with any certainty. We suggest that a revised draft EIS is needed to evaluate the impacts should both OCS and imported oil be transported to and processed in the Mid-Atlantic region.

An additional misconception developed in the DES is that petrochemical industries will not be attracted to the region. It is very possible that the OCS supply, because it is more secure than imported oil, may attract the petrochemical [illegible]stry. Experience in Scotland resulting from North Sea [illegible]rations, has shown that fertilizer factories and other petrochemical industries have been attracted to the vicinity of refineries.

c. Population Impacts: The description of the impacts on localities and on population shows that rural areas will bear a significant impact from offshore oil and gas development. Private investment will increase substantially (DES II-194), which will in turn, induce people to the area seeking employment. The impact statement asserts that these effects will be largely short term, and will subside after peak production (Ibid. p. 208). However, this assertion fails to recognize the severe adverse impacts of short term peaks. Recently Fairbanks, Alaska has been receiving large influxes of unemployed people searching for work. This has changed the entire social and economic fabric of the town.

The DES leaves unclear whether the 1985 peak population change of 20,800 (DES II-205) and the 1990 peak population change of 9,000 attributable to OCS development refers to employed persons only. If these employed people have families, the effects will be considerably increased. (DES II-208). In addition, it is unclear whether these population estimates include population generated by secondary development. If not, the effects again will have been greatly understated.

Although the impact statement contends that population characteristics would not be changed by OCS development, it later states that "No accurate predictions of the future OCS induced population can be made". (Ibid, p. 206). In light of this, it is not acceptable for the BLM to conclude that growth will be insignificant (DES II-209).

d. Land Use Impacts: This section commences with acreage requirements for OCS related facilities. The total acreage requirements are expected to be between 70 and 265 acres in coastal areas, increasing to approximately 645 acres in the region (Ibid, p. 220). This estimate is a long way from the programmatic DES which estimated that OCS development would impact 21% of developed land. (Programmatic DES II-233). The changed projection is not adequately explained. For one thing, the present estimate does not account for the acreage required for secondary development. The siting of any industrial or OCS related development will necessitate and attract related service facilities. This section does not fully deal with OCS related activities which themselves will affect trends in land use in the surrounding region.

The land use estimate leaves it unclear whether it shows total acreage or merely the land per use with no attempt to describe the number of times that use will be needed.

Since numerous sites seems likely (otherwise 8 gas processing plants only need 20 acres!) one can calculate that in a maximum development situation, operations bases must be multiplied by at least five, or one base for approximately every 10 platforms (Henry Hill, Regional Exploration Manager, Conoco, personal communication, October, 1975), and by at least 8 for gas processing plants.

The degradation of 250 acres of wetlands is discussed as a likely possibility (DES II-222). Wetlands are one of the most productive ecosystems of the eastern coast. Their value and need for protection has been exemplified by the states' adoption of tidal wetlands laws which severely restrict permitted uses of wetlands. Dr. Eugene Odum who has done extensive studies of wetlands, estimates that the value of wetlands ranges from $100 to $4100/acre.* The impact statement does not fully describe the ecological or economic impact from the loss of 250 acres of wetlands. In addition, the 250 acres represent only those wetlands to be directly altered by the program. Those adversely affected by chronic oil pollution, for example, are not counted. Nor are those lost due to secondary development, dredging and filling. These losses must also be counted and quantified in economic terms to the maximum extent possible.

---

*James Gosselink, Eugene Odum, and R.M. Pope, "The Value of the Tidal Marsh," Work Paper No. 3 - Univ. of Ga. Urban & Regional Development Center, May, 1973.

The DES considers land use impacts to be potentially significant (DES II-218 - 228), however, it recognizes that the significance depends on the controls imposed by states and localities to mitigate these impacts. Thus BLM is essentially stating that it is proposing a program, some of the major impacts of which are not its responsibility. Since this is the case, it is essential that states be given time to complete their coastal zone plans before BLM's program goes forward.

III. D. 1. e. Recreation

The DES cavalierly notes that crowding at beaches is already sever, and concludes that a little more crowding onto clean beaches as a result of a spill on another beach would not be "noticeable" (DES II-238). Aside from involving further crowding in the densest urban environment in the nation, this statement apparently does not consider the possibility that the oil will not selectively strike one beach but could affect beaches throughout the region.

Although the impact of pollution on recreation is mentioned in the DES, it is not included in the projections of the economic model in Technical Study No. 1. As recreation and tourism are one of New Jersey's major industry's, the omission of its consideration in the determination of economic impacts results in a gross understatement of the possible adverse economic consequences associated with OCS development. Pollution from an oil spill is not the only problem. Emission from refineries is anticipated to raise Cape May's SO_x emission to 8-70 times the national average (DES II-243). This projection is with no additional refinery capacity.

III. H. Cumulative Impacts

The section of cumulative impacts is perhaps the most revealing section of the draft statement. After hundreds of pages of facts assessing the specific impacts of the lease sale, we are told that the total impacts will be proportionately greater as this sale is only the first of two already planned. In addition, if abundant supplies of oil are found, it is presently undertermined what the extent of future sales and resultant impacts may be.

This section tends to invalidate all the definitive statements made previously in the DES. All projections on refinery capacity, gas processing, population increases, port facilities, etc. are only a fraction of the total impact. The study should have explored the effects of total development of the Mid-Atlantic OCS as presently planned, as well as the effects of the incremental development.

The major misconception generated in this DES is the assumption that the degree of facility development and the location of that development are of too small magnitude to disrupt the regional demographic and economic characteristics. The truth in this statement is limited by at least two facts: First, any siting of oil and gas related facilities resulting from this sale will draw additional development to those locations. Thus the cumulative impacts generated by the impending sale could reach very serious proportions. Second, the DES misleads the public with its assessments of impacts by not assessing the possible impacts associated with the whole Mid-Atlantic leasing program. As most of the calculations in this statement are based on models and other assumptions, the BLM should have written a statement evaluating the cumulative impact of the 1976 and 1977 sales together. Because this draft statement is so limited in scope, its utility is severely diminished.

IV. Mitigating Measures Included in the Proposed Action

A. Federal Regulations and Enforcement

1. Department of the Interior

Special Stipulations

The utilization of special stipulations (such as those referred to in this subsection and set out more fully in Section IV.E) represents an important means by which government may exercise control over exploration, development and production and assure consistency with maintenance and protection of important environmental goals. However, the "special stipulations" proposed (DES II - 357-367), in addition to being only "tentatively approved" by the Department of the Interior, fall far short of the goal of assuring the conduct of leasing activities in a manner consistent with environmental concerns. Because of their potential value as mitigating measures, our discussion of this subsection will focus on some of the special stipulations proposed.

Biologically Important Areas. The proposed stipulation fails to define "area of special biological significance." However, the language of the stipulation indicates that the term applies to a "unique biological resource" or "anomalies". This affords too limited protection since many biologically important areas are of value not because of their uniqueness, but for other reasons such as their productivity. In addition, biologically important areas should be protected whatever the manner of their discovery. The term as presently written refers only to discovery during exploration, development and for production, or as a result of BLM Baseline Studies. It is conceivable that other circumstances could lead to discovery of an important area and this eventuality should not be precluded. The most critical failing of the proposed stipulation is reflected in its use of the word "until" as opposed to "unless" in the first paragraph. By utilizing the word "until," the real value of the stipulation is undercut. The government should retain the right to limit or even terminate exploration and/or development of certain tracts should the operator be unable to prove that adequate technology and safeguards exist to prevent "significant detrimental impact" to biologically important areas.

Placement of Structures. With respect to this special stipulation, greater protection would be afforded by use of the term "no *feasible* alternative placement" in lieu of "no reasonable alternative placement." In addition, once it appears that location of a structure may interfere with a significant ongoing use of the OCS, such as commercial fishing, the burden should be on the operator to show that such location is necessary and no feasible alternative location exists.

Shipping of Oil. We approve of this stipulation in principle; however, the requirement that crude oil be brought ashore via pipeline in lieu of tanker should not be stated in such a heavily qualified manner. For example, the DES states: "we propose that to the most practical extent possible, oil produced in the Mid-Atlantic OCS be prohibited from transport via tankers and barges." (DES II - 361) (emphasis added). This appears to be a weaker version of the "maximum extent" test. The language of the stipulation itself talks in terms of the economic feasibility of pipeline utilization. What standard is to be used in measuring economic feasibility and upon whom will the burden of proof fall, the operator or the government? If surface vessel transport is to be used instead of pipelines, the burden should be placed on the operator to prove that (1) no feasible alternative exists to bringing the oil ashore by surface vessel and (2) that surface vessel transport can be conducted in such a way as not to adversely harm the environment.

Pipeline Burial. Again, rather than qualify this particular stipulation with the term "Whatever technically and economically feasible," the government should require pipeline burial and place upon the operator the burden of showing that such precaution is either not possible technically or is not economically feasible.

Right to Terminate. The DES fails to propose, or even consider inclusion of a stipulation preserving the government's right to terminate a lease if future information establishes that termination is necessary to protect the environment. Inclusion of such a stipulation, which would allow a decision to be made once exploration has occurred and Baseline Studies conducted, is essential to attainment of NEPA's goals. This is particularly true because of the present lack of information on many critical environmental issues which the DES itself recognizes. If the results of the Baseline Studies are to be meaningfully applied, the government should maintain the option of termination.

1.b. USGS

The DES fails to disclose what technologies will be required in connection with exploration development and production, e.g., best available technology with something less. The inspection procedures which will be followed are also not spelled out. How many inspections will be madeover what period of time? The DES states simply that "All operations, regardless of the activity, will receive regular on-site inspection." (DES II-315). The failure of the DES to be specific on these points is troubling in light of the GAO Report to Congress* which found that the USGS did not enforce its orders to the fullest extent possible, failed to adhere to its own regulations on the number of inspections required and was generally weak in its surveillance and enforcement mechanisms. The DES should consider and propose means by which enforcement of regulations and orders will be assured, otherwise USGS' surveillance and monitoring system runs the risk of being highly inadequate.

---

* Improved Inspection and Regulation Could Reduce the Probability of Oil Spills on the Outer Continental Shelf, Rpt. to the Conservation and Natural Resources Subcommittee, Committee on Government Operations, House of Representatives, by the Comptroller General, June 1973.

There are several major problems with the new procedures for state consideration of OCS oil and gas development plans. First, the utility of development plans minus the proprietary data is severely limited. Under existing laws, the Department has allowed most OCS information relating to exploration and development to be classified as proprietary. Thus, the degree to which coastal states will be able to use the development plans submitted to them "to prepare for any environmental and socio-economic impacts which might result from development" is highly questionable. For truly effective mitigation, the states and the public should be provided with all OCS oil and gas leasing and development information in a form useful for planning and decisionmaking. This would require inclusion in the development plan of interpretations of data, as well as the data itself. It would also mean making the development plans available to the public, as well as the states, for review and comment. A second serious drawback to the new procedures is the fact that whatever a State's reaction to a development plan might be, USGS is under no obligation to heed the state's recommendations.

The preparation of environmental impact statements in connection with USGS' action in development plans is never considered or discussed. A NEPA analysis at that critical juncture may be a necessary and valuable means of analyzing and assuring effective mitigation of adverse environmental impacts associated with development and production. The failure to require preparation of impact statements in the development plans, or to even discuss such a requirement, represents a serious deficiency in the DES.

B. State Regulation

As discussed elsewhere in these comments, the ability of the states to mitigate onshore impacts associated with OCS development is severely hampered by the commencement of this leasing program prior to completion by the states of their coastal zone management programs. In addition, unless full disclosure of oil company development information and plans is required, states will be at a great disadvantage in preparing for onshore facilities and their associated impacts.

C. Oil Spill Curtailment and Cleanup

A strict and effective oil liability system needs to be established to promote the curtailment of oil spills. The DES fails to propose or consider alternative systems. Strict liability without regard to fault for all damages, including cleanup costs, sustained as a result of oil or gas from leasing operations, and for rehabilitation and restoration as well should be imposed. The benefits associated with imposition of such strict liability should be recognized and assessed in this section of the DES. They are not.

V. Adverse Environmental Impacts Which Cannot Be Avoided

As stated in NRDC's comments at the Atlantic City hearings, this discussion of adverse impacts is inadequate. Quantification is rarely used. Furthermore, there are a number of impacts discussed in this section which can be avoided if the federal government takes a strong stand on the operational requirements of OCS development.

A. Marine Organisms: The discussion of adverse impacts is inadequate. Drilling mud impacts are only discussed in relation to increased turbidity, not to heavy metal pollution, the impact of which is much more long term and potentially destructive to marine organisms. This section does not recognize the serious potentials from oil spills and chronic oil pollution.

C. Wetlands and Beaches: The discussion of the adverse impact to wetlands and beaches does not indicate the magnitude either physically or economically of the loss if those two ecosystems are permanently damaged. Beaches do not serve a recreation purpose alone. Damage resulting from pipeline burial could permanently alter the ability of a beach to act as a protective barrier to estuarine environments. Barrier beaches serve an additional flood protection role to shoreline communities. The draft statement does not fully evaluate what such an alteration in natural systems might mean in terms of long term productivity of the ecosystems.

The discussion of impacts to wetlands is equally cursory. This section does not include the 250 acre loss estimate contained in an earlier section of the statement. The values of wetlands are not alluded to, so the quantifiable loss is not calculated. In conclusion, although the statement indicates what the kinds of adverse impacts might be, it does not evaluate what the result of impacts would be in terms of productivity loss and economic loss.

D. Water Quality: The discussion of onshore water quality is inadequate. The potential of thermal pollution is not discussed. In addition, there is no attempt at quantifications. Calculations are made in wide ranges, for instance, a 10-100% increase in sewage loadings is projected. This information cannot be used beneficially in planning for onshore impacts.

E. Air Quality - Onshore: No quantification is presented on levels of air pollutants which may be expected from this program. Even more significantly, this impact statement does not discuss the impacts from increased levels. Numerous studies have been done on the health effects of sulfur oxides, the impact of acid rain on vegetation, the problems of particulates in lungs. Furthermore, the pollutants could be a substantial detriment to the large recreation and tourist industry of southern New Jersey. Failures to discuss these adverse impacts represents a true departure from the intent of NEPA.

F. Land Use: The discussion on land use downplays the impacts. It does not adequately address the problems associated with rapid industrialization of rural communities. Furthermore, the land use impacts are likely to be more significant than the projected use of 645 acres maximum. Brown & Root has already acquired a 2000 acre site in Virginia for platform construction. Competing companies in all phases of OCS operations will require their own acreage and facilities. It is possible that OCS operations will not be centralized, but instead, scattered up and down the Mid-Atlantic Coast. This kind of development is not discussed as an impact of this program. The acreage estimates therefore appear highly inaccurate.

G. Socioeconomic: Again, socioeconomic impacts are couched in such general terms as to make this section unusable for evaluating the true impact of the program, or to plan for mitigation of the impacts.

VIII Alternatives to the Proposed Action

The first part of this section discusses the DES' description of the alternatives, while the second part discusses the alternatives not considered.

I. Alternatives discussed in the DES

A. Modification of Sale

1. Delete Tracts

The DES discusses the possible deletion of either the southern or northern portions of the proposed lease area. We recognize the validity of considering deletion as an alternative, however, the DES's discussion is frustrated by the lack of information available on either of these portions.

The discussion itself does not conform to information contained in previous portions of the DES. The suggestion that tankers would be used to transport oil from the southern portion (DES II-398) contradicts previous sections which maintain that the bulk of oil will be transported by pipeline from the lease area. No distinction has been made as to different characteristics of the north and south portions, and no reason is given for making a distinction here.

The DES makes the unsupported argument that any reduction in size of acreage to be leased would reduce the extent to which the U.S. could achieve self-reliance in energy. The DES is devoid of any demonstration that energy self-sufficiency would be promoted in any way by production of oil from Sale 40. Even if the price and the characteristics of imported oil permitted substitution by domestic reserves, the rapid and continuing rise of oil imports means that offshore oil would be of little significance - approximately 3% of daily national oil consumption at present rates of consumption.

2. Substitute Tracts

This section is similarly devoid of any usefulness in decision-making, as there is no information to evaluate why any one tract would be a wiser choice than any other.

B. Delay the Sale

1. CZM Plans

The DES concludes that since production activities and the construction of what it calls "permanent" onshore operations will likely occur after the mid-1977 hypothetical completion date of the State CZM plans (DES II-409), there is no need to delay the lease activity until that time. This assumption is inaccurate for two reasons. First, Congress is now considering an amendment which would extend the completion date for CZM plans for at least a year past the 1977 date. Second, impacts are associated with exploration and preparation for the offshore drilling programs. The DES assumes that exploration activities will be operated out of existing facilities (DES II-410). There is no basis for such an assumption, and the large scale of the effort needed suggests otherwise.

DES misconceives, in any case, the significance of the CZM planning effort: CZM planning must be in place before the impacts resulting from the operation of the program are permitted to occur. The DES, far from making the gratuitous assumption that all state CZM programs would not only be implemented but implemented on time should have considered an alternative with the absence of any such plans.

The one benefit of a delay, as recognized by the DES (II-412) would be the time gained for coordination and consideration of information exchanged between state and federal governments. Another benefit, also recognized by the DES is the availability of more information, and its broader dissemination. These benefits cannot be underestimated. As the DES now stands, it is impossible to weigh alternatives, as the information necessary to do so is lacking.

This is not an area in which additional information is merely incremental. More information on the OCS, on the nature and amount of petroleum, on the ecosystem, on the onshore impacts, could have wide-ranging impacts covering the entire scope of the planned development. Considering the scarcity of data now available to both CZM planners and to the government, it may be seen as indispensible to intelligent execution of the mandate of the Coastal Zone Management Act that action on the OCS be delayed until such time as CZM planning is in place. To proceed now to OCS development without knowing to what extent CZM programs will be affected by OCS development amounts to a reckless gamble with the region's coastal resources.

2. Completion of Baseline and Other Studies

This alternative is not merely an alternative but the *sine qua non* of the informed decision-making required by NEPA. It is extremely unsatisfactory that the DES makes only a cursory effort to describe the studies which have been commissioned. It appears that such studies are purely descriptive, and not analytical of the present marine ecosystem. As the DES implicitly recognizes, there is little room for meaningful reconsideration of a sale if it should appear as a result of further study that a particular tract should not have been sold (DES II-414). As the Interior Department will not consider including termination clauses in the leases, it will be extremely difficult to impose any retroactive restrictions on production and of course it would be too late to restrict exploratory activities.

Delay until baseline studies are completed is necessary then to protect the government's freedom of action as far as determining which tracts to lease and under what conditions.

3. Development of New Equipment

This alternative is considered not "viable" (DES II-414) for the simple reason that radical improvements in the ability to protect the OCS under conditions of more than 2-knot currents or several foot waves are not anticipated (DES II-415-417). In view of the inability of any potentially available equipment to operate effectively in open seas under conditions typically to be found in the winter in the Atlantic Ocean (DES II-417), the necessary conclusion must be not to lease since we are unable to protect the environment precisely at the times (of storm) that it is most endangered.

C. Withdrawal of Sale

1. Energy Conservation

The DES' conclusions regarding the alternative of energy conservation are not supported by figures or statistics.

The cause of energy dependence is not the decline of energy supplies but staggering increases in per capita energy consumption (doubling every decade since World War II). Energy conservation -- including the elimination of wasteful energy distribution as well as consumption patterns -- can potentially do far more than OCS drilling to achieve energy dependence goals both in the short and long run.

Energy conservation would result in more efficient use of existing energy sources and energy resources, would preserve and extend domestic production capability and would make possible a smooth transition, with minimum environmental consequences, to a non-fossil fuel energy system.

Assuming that maximum average estimated production of 285,000 bbl/day (DES II-11) and 1 billion CF (9.4 TCF divided by 9,125 days) is achieved,* this production level is the equivalent of 1,687,250 x10^6 BTU daily production. On a basis of 10,000 BTU/KW, this total works out to about 268,725,000 KW of daily production. If British experience in a comparable field is correct, development will cost $1 billion. (N.Y. Times 9/14/75 p. 10).

---

*The DES uses the higher (January '75) USGS estimate of recoverable reserves in comparing quantities of energy required. This is misleading because these estimates have been repudiated by USGS and much lower ones substituted. While retaining the higher estimate for purpose of tracking with the DES' comparisons, the results in these comments should be reduced by at least one-third in the case of both oil and gas to track with the revised estimates (DES, Vol. 1, p. 1).

There is no reason to think that this amount of energy could not be saved at the present time under available technologies. The Energy Policy Project of the Ford Foundation estimated last year that 24.2 Quadrillion BTU could be saved by 1985 with relatively minor measures of conservation in residential, commercial transport and industrial sectors; it estimated that the same measures could achieve savings triple that amount by 2000.* The following methods have been demonstrated:

- energy conservation practices in existing commercial buildings would save a fourth of energy now used for heating and cooling through insulation, double-glazing, etc., at a cost that will repay itself in four years. A more complete system that would repay itself in less than a decade would save 40% of energy so used;**

- energy conservation practices in new commercial buildings would save half of energy costs and repay themselves in five years;***

- energy conservation practices such as installation of storm windows, insulation, and setback of thermostats at night would save a 35-40% of energy costs and repays itself in less than a decade;****

- energy conservation by use of total energy systems which generate heat and power simultaneously saves twenty to forty percent of energy consumed and, in new buildings, would pay itself back in less than a decade;

---

*Energy Policy Project of the Ford Coundation, 1974, A Time to Choose, p. 45.

**Oral Communication, Dubin, Mindell & Bloome, Inc., Engineering Consultants, N.Y. N.Y.

***Ibid

****Ibid

*****Ibid

- energy conservation by retrofitting old oil-fired steam power plants with gas turbines at average cost probably $150-200/KW. Such retrofitting would increase fuel efficiency of the plant from the present 25-30% to 32-37%.

2. Conventional Oil and Gas Supplies

The DES makes no effort to discuss the impact of changing prices for oil and gas, or the impact of price deregulation, on secondary and tertiary recovery of oil and gas. Such recovery is highly elastic. Changing price levels will result in increased rates of U.S. production so as to reduce any imagined need to produce frontier areas at this time. Secondary and tertiary production is now taking place. (N.Y. Times, 12/15/75, p.31) It has been estimated that an increase of 1% in recovery rate would produce an extra four million barrels; and the BLM has estimated that such production could increase recovery by 10 billion barrels by 1977-1979. (Congressional Quarterly, 6/8/74, p. 1465).

As far as overall oil and gas supply is concerned the assumption that increased U.S. production can result in any meaningful lessening of "dependence" on foreign oil is belied by independent studies of future import levels.

A recent Library of Congress study has concluded that the goals of Project Independence are unattainable. (N.Y. Times, 12/25/75.

Similarly, a study by A.D. Little to assess the feasibility for power generation of electric utility fuel cells for Electric Power Research Institute concluded, in its final report, that

> "even with...fairly conservative growth rates in oil demand...we foresee imports to be 40% and 35% of total demand in 1980 and 1985, respectively." *

The report predicts that oil imports will rise to 7.9. million barrels/day by 1985, at 2-18, and that, for instance, residual fuel oil would cost between $2.30 and $2.82 in 1985 and would average $2.40 per barrel by 1990, at 2-3.

7. Solar Energy

The DES inadequately describes the attractions of solar energy as an alternative to OCS leasing. Solar energy will, as the DES recognizes, "be available in a significant scale in 10 to 15 years". (DES II-444) The DES makes no effort to evaluate the energy costs of exploiting solar energy as opposed to exploiting OCS oil and gas, or to assess the potential for accelerated solar energy development as an alternative to such development. Solar energy for heating and cooling could result in considerable fuel savings by retrofitting flat-topped commercial buildings in the Northeast with solar panels. Individual homes can install solar water heating units, and directly reduce fuel consumption, at a cost of $2,000 per home.

---

*EPRI, Assessment of Fuels for Power Generation by Electric Utility Fuel Cells, A.D. Little, Oct. 1975, at 2-16.

8. Oil Imports

The DES fails to provide any documentation that the sale will affect imports of oil, yet the sale is justified repeatedly on the basis that it will take the place of oil that would otherwise be imported. This cannot be accepted without documentation as to the price of oil, the nature of the oil, and the expected demand pattern for oil. None of these figures are supplied by the DES. As was pointed out above, two recent studies have concluded that oil imports cannot or will not be reduced in the foreseeable future.

12. Other Energy Sources

The DES fails to discuss some of the most hopeful of the alternative energy sources

- wind generation

  ERDA will demonstrate a 1.5 MW wind generator by 1980.

- OTEC plants (ocean-thermal)

  OTEC plants involve the same technology as drilling platforms. A demonstration 100 MW plant is planned for 1985 to cost $500 million Estimated cost is $2500/KW as opposed to $3700/KW for OCS drilling.

- waste conversion

  The burning of waste may be one of the most significant potential sources of energy. The Connecticut Resource Recovery Authority has already commenced work in this area.

D. Alternative OCS Leasing Areas

The DES unwarrantably avoids any discussion of the desirability of a ranking of lease sales on a scale of environmental impact.

It is clear that the guiding principle in the Program is not protection of the environment but the immediate exploitation of the most lucrative fields. The DES allows the short-term consideration of cost effective deployment of production platforms to override an environmetnal cost effectiveness calculation. The BLM thus belies its own invitation to the public and to other agencies to suggest rankings to govern the decision to lease. Contrary to the DES(II-463) environmental impacts are not invariant with area: they will differ profoundly with the temperature of the water, sea-state, nature of the coastal habitat bordering the base area.

E. Alternatives within the Proposed Action

1. Government Exploration Prior to Leasing

The discussion of this alternative is seriously deficient. No attempt is made to trade off the actual potential cost against the value of the information derived. The conclusory statement concerning the "cost effectiveness" of the present system is totally without documentation. There is no discussion of government taking a part-interest in an exploratory effort. There is no discussion of the historical relation between estimated production and actual production so as to determine whether there is any need for better information. There is no discussion of a complimentary reform, i.e., requiring companies to provide so-called "proprietary" information concerning potential reserves in the bidding process. The companies can have no valid reason to object to providing such information to the government as lessor. The government is in fact participating in an exploratory effort at the present time. (N.Y. Times 12/12/75)

2. State Participation in Decisions

This alternative, involving a suspension period between exploration and development, is inadequately discussed. No description is provided of what kind of "participation" is contemplated: whether suspension periods could be further extended by the states; whether locally affected communities would "participate"; whether and in what form criticisms of proposed company actions by states would be incorporated into leasing decisions; what the purported "costs [of delay]...passed on to the consumer" would be; whether unitization, described in terms of resource conservation, should not also be mandated on environmental protection grounds; what the nature and scope of a broadened - and not yet existent - "development plan" would be. A decision to proceed with a sale on the ground that future environmental safeguards might be established - seems to frustrate the intent of NEPA that a unified assessment of environmental consequences be made before major federal actions are taken.

II. Alternatives Not Discussed in the DES

A. Variations in Bidding Procedure

Different forms of bidding should have been discussed since different forms, such as those proposed in HR 6218, would have different effects on the extent to which full recovery of reserves is assured. In turn, the extent of recovery would have environmental effects as more or less oil or gas would be produced.

Among the forms of bid described in HR 6218 are included:

- cash bonus with fixed royalty;
- variable royalty with cash bonus;
- diminishing or sliding royalty changing with amount of remaining reserve, with cash bonus;
- cash bonus with reservation of fixed share of net profits to U.S.;
- cash bonus with variable reservation of share of net profits to U.S.;
- cash bonus with royalty and percentage of net profits;
- competitive performance bid.

B. Lease provisions: A lease termination clause.

Of the many provisions which might be included in a lease or in regulations, a provision allowing the Secretary to terminate the lease on environmental grounds is essential. This alternative should have been discussed in the DES.

Its importance is manifest: it allows the Secretary to prevent a situation which has been recognized as being environmentally destructive from continuing and perhaps worsening. It removes from the lessee the necessity of deciding between continued profit and environmental risk or damage.

The Programmatic Program Decision Option Document (PPDOD) maintains that the Interior Department has no authority to adopt a provision for the termination of a lease. This assumption has been continually refuted by environmentalists, and should be carefully examined in this Draft Environmental Statement.

C. Variations in Percentage of Government Take

There is no reason why the government share of revenues or profit should remain as low as it historically has been. A higher government revenue component could help to finance environmental protection or alleviate the socio-economic effects of drilling at the state and local level.

The British government's total revenue derived from oil development in the North Sea is 73% of the value of the oil, a large part of which is comprised of a tax of 45% on oil revenues, apart from royalty and corporate income tax. (N.Y. Times 9/14/74, p.10) The tax has not resulted in failure to develop the North Sea reserves. There can be no reason to not consider the desirability of similar revenue measures in regard to Atlantic production.

National Coalition for Marine Conservation, Incorporated

CHRISTOPHER M. WELD, SECRETARY
225 FRANKLIN STREET
BOSTON, MASSACHUSETTS 02110
617-423-7474

February 17, 1976

Department of the Interior
Bureau of Land Management
New York OCS Office
New York, NY

Re: Comments on Draft Environmental Impact Statement Relating to Proposed 1976 Outer Continental Shelf Oil and Gas Lease Sale Offshore the Mid-Atlantic States

Gentlemen:

The following comments are made to you on behalf of the National Coalition for Marine Conservation and relate for the most part to fisheries considerations:

VOLUME I

Page 18

Section I.D.II. states that the Bureau of Land Management is currently undertaking baseline studies in the Mid-Atlantic OCS to increase knowledge of fisheries -- among other things, yet there is little evidence of anything except the most superficial knowledge concerning fisheries generally or sportfisheries in particular.

Accurate and complete information concerning the nature of fishing acitivities and the catch in the proposed development area must be included in order that short-term benefits and long-term benefits can be weighed. Since much of this information is available from the National Marine Fisheries Service, it is difficult to imagine why this information was not included.

Page 421

The statistics used in Section II.G.f. relate to the commercial catch in the coastal waters but do not indicate whether a

"Let us face in time the fact that the ocean can be destroyed"

significant portion of the catch comes from areas most immediately subject to impact by OCS development activities.

Page 457

The Section entitled "Sport Fisheries" should include the 1975 statistics published by the National Marine Fisheries Service (Participation in Marine Recreational Fishing, Northeastern United States 1973-4 -- Current Fisheries Statistics 6236, January 1975). These statistics show a far greater number of sportfishermen than earlier surveys conducted by the U.S. Bureau of the Census in 1965 and 1970.

This section fails to include any information concerning so-called big-game fishing -- sportfishing for bilfishes, tunas, dolphins, sharks and other species more likely to be found offshore than near shore. While fewer persons may participate in such fishing on account of cost, skill and availability factors, it is nevertheless a very significant economic aspect of sportfishing.

This section should reveal whether or not significant sportfishing takes place in the proposed development area. There is, for example, substantial sportfishing for white marlin, broadbill swordfish, mako sharks and blue marlin along the outer continental shelf from east of the Hudson Canyon to and beyond the Baltimore Canyon from such sportfishing centers as Brielle and Cape May, New Jersey; Ocean City, Maryland; and Virginia Beach, Virginia. This fishing involves a large fleet of private and charter boats running 40 to 100 miles offshore throughout the period that the target species migrate through the area.

Such species, and therefore the sportfishery dependent upon such species, prey upon herring, mackerel, ling, butterfish and other species which reside in the area before and after the northward migratory cycle of big game fish. Therefore, such forage species in addition to being important commercial species are a vital factor in the sportfishery, and because they reside in the area for a longer period of time and because some or all of them spawn in the area, such forage species are more vulnerable to adverse impact on account of OCS development activities.

VOLUME II

Page 16

The discussion of pipelines in Section III.1.c. should contain a discussion of the possibility of such pipelines being cut by trawlers, and the possibility that tidal action may uncover buried pipelines and render them vulnerable to damage from trawl boards.

Related to this discussion, of course, is the lack of information concerning fishing activity in the proposed development area and the proposed pipeline corridor and the question whether it is anticipated that trawling will be banned in the vicinity of pipelines. If such prohibitions are under consideration, the loss of revenues on account of curtailed trawling activities should be identified as another impact.

Page 19

The assumption is made in Section III.2. that the probability of oil spills in the Mid-Atlantic should be about the same as in the Northern Gulf of Mexico. Such an assumption should be supported by a comparison of actual and anticipated ship traffic in the two areas. It should also be noted that there is no bottom trawling in the Northern Gulf of Mexico. Moreover, the statistics employed appear to be biased by the apparent failure to include the recent collision of a trawler with a production rig off the Texas coast and the major spill which ensued.

If the shipping and commercial fishing activity in the proposed development area is significantly greater than in the Northern Gulf of Mexico, the risk of collision and consequent spills will be proportionately greater.

Page 22

The Section on Pipeline Accidents should mention the added hazard posed by bottom trawling, if in fact, fishing vessels engage in bottom trawling in the proposed development areas or in the proposed pipeline corridor.

Page 26

In the Section on Tanker Accidents and Operations as well as elsewhere in the Environmental Impact Statement, it is stated that certain levels of risk will not increase because OCS oil will serve to replace importation of foreign oil. This is a patently spurous assumption. Given (i) continued diminution of production in America's mature fields, (ii) continual increases in demand, (iii) a federal government strategic petroleum stockpiling program, and (iv) increases in East Coast refining and storage capacity, it is obvious that OCS production will merely augment imported oil. Moreover, tanker transport of OCS production involves a greatly increased risk of spillage because it involves at least two and probably four on-loading and off-loading cycles in coastal waters while importation involves only a single off-loading.

In addition, coastal vessels tend to be smaller capacity vessels, requiring a greater number of tanker than would be used to carry the same amount of imported oil. A significant increase in tanker traffic has to mean a significant increase in the possibility of collision.

Page 51

Section III should contain an analysis of the effect of chronic discharges inherent to offshore development activities. If no research has been conducted as to the cumulative effects of such chronic discharges, such research should be done prior to permitting exploration and production in or near areas from which substantial commercial catches are taken or in which there is substantial spawning.

Page 67

On page 21 it is stated that "statistics represent oil spills of all types ranging in size from a few gallons to tens of millions of gallons". Why then are predictions of oil spilled from blowouts, etc. on page 67 limited to several thousands of barrels?

Page 69

Spillage should not be dismissed as being of no significance because they would "produce only incremental increases in the levels of hydrocarbons in the area waters". The various incremental increases must be considered cumulatively and they must be considered together with the toxic materials, sewage, sludge, heavy metals and other noxious matter dumped, pumped, drained or otherwise introduced into the marine environment on a regular basis. In this connection reference is made also to the statement on page 104 to the effect that sublethal effects from oil pollution are the least known and potentially the most dangerous to fish.

Page 75

The assumption that OCS production will replace foreign oil imports has already been commented upon.

Page 76 - 77

It should be noted that several of the species included in Table III - 21 (fish species having planktonic larvae) are significant forage species which are essential to the occurence of a large number of important commercial and recreational target species which are not included in the table.

Page 79

We are under the impression that the conclusions of Oguri and Kanter concerning adverse effects after the Santa Barbara blowout have been discredited and are in any case inconsistent with later studies.

Page 85

Some species of fish having planktonic larvae have been heavily and repeatedly overfished in the subject area. Mackerel and herring in particular have been depleted by foreign fishing. Substantial damage on account of oil spills together with a poor year class could cause the most severe damage to these crucially important stocks.

Herring are the basic feed stock of the northwestern fisheries. In recent years increasing scarcity of herring have affected the abundance and availability of other species in many areas. Accordingly, such impacts may not be either local in effect or temporary in nature.

For this reason it is crucial that the most stringent safety regulation and anti-spill or blowout measures be incorporated in the terms of the leases.

Page 104

The statement referred to earlier that "the sublethal effects from oil pollution, especially from the chronic low level discharge of oil into the marine environment, are the least known and potentially the most dangerous to fish" emphasizes the necessity of further research and the importance of shielding important fisheries areas from such spills.

Page 134

The second sentence of Section III.2a. states "Because there is no catch data available for the Mid-Atlantic at the present time on a specific area basis, and the impacts on fish populations resulting from oil and gas development are largely unknown, the impacts discussed below are not quantifiable". In other words, because of a lack of information it is impossible to judge the value of short-term energy gains against potential long-term nutritional losses.

Catch data on a specific area basis should be easily obtainable. Certainly, it should be readily determinable whether or not significant catches are taken in or near the proposed development area. Moreover, since offshore petroleum development is expected to be accelerated, impacts on fish populations should be analyzed as soon as possible.

Page 134

Given the large turning radius of trawlers with fishing gear deployed, the occupation of 5 to 162 acres by each drilling structure represents a substantial interference with a trawler's ability to operate in the vicinity of such structures. Such interference contributes an additional impact to the extent that it impairs the efficiency of trawling operations in the proposed drilling area.

Page 135

In the second paragraph it should be noted also that the existence of pipelines as well as structures would have an impact upon trawling.

Page 138

Reference is made to paragraph (2). Comment has already been made concerning the already depleted condition of some stocks in Mid-Atlantic offshore area. The serious consequences of the destruction of "entire year classes of juvenile or larval fish" of an already depleted species should be analyzed and disclosed in order that it can be taken into consideration in balancing short-term benefits against long-term consequences. In general, the Environmental Impact Statement gives little indication that serious consideration has been given to this type of trade-off.

Page 147

Any discussion of impacts upon near shore spawning grounds is incomplete and misleading without a full discussion of (1) habitat losses which have already occured, (2) the importance of estuarine and coastal wetland areas in the life cycle of many species, (3) the biological fragility of such near shore and shoreline areas, and (4) an analysis of the effects of substantial and repeated spills upon such areas. Such effects must be taken into consideration in determining whether adequate safeguards are available and will be imposed upon developers.

Not only dredging but a near shore pipeline rupture or tanker collision could result in spills that would have a substantial adverse and possibly permanent effect upon spawning, nursery and habitat areas.

Page 312

The statement to the effect that proposed stipulations may be imposed upon developers is not very reassuring. The stipulations should be rationalized and improved. The fact that they exist in a vague and unapproved form is meaningless.

Page 313

The statement to the effect that the BLM environmental studies program will provide information which can be used to develop special stipulations is also unreassuring. A study program that developed so little information for the purposes of the Environmental Impact Statement is unlikely to lead to meaningful environmental safeguards.

Page 313

It is unclear from the discussion under Section IV.1.b. whether the OCS development regulations promulgated by BLM and the lease stipulations will constitute a standard of care sufficient to permit the inference that adequate environmental safeguards will be required and enforced in connection with OCS development. Since this is crucial to the judgment process which the Environmental Impact Statement is intended to facilitate, the Environmental Impact Statement should contain a more detailed discussion of the regulations and the stipulations, their intended effect and their legal significance.

Page 315

Discussion of the inspection program should include a discussion of the inspection capability of the U.S.G.S. If inspections are to be carried out by U.S.G.S. personnel, are trained personnel available in adequate numbers? If Coast Guard equipment will be required to transport U.S.G.S. inspectors to the inspection site, is such equipment available? Will such transportation divert Coast Guard personnel and equipment from fisheries surveillance duties? If so, this would constitute yet another impact of OCS development.

Page 359

The meaning of "area of special biological significance" is so vague as to be meaningless. The concept should be expanded to define areas in which special precautions should be taken in order to protect the "biologically significant" features of such area and areas which should be avoided altogether on account of their biological significance. Such definitions should be sufficiently precise as to constitute an ascertainable and enforceable standard.

Page 359

The stipulation should provide that the lessor -- not the lessee -- shall conduct "specific surveys ... to determine the potential existence of any unique biological resources that may be adversely affected by any lease operation". The lessee cannot be expected to have either the capability or the desire to make the required determination.

Page 363

The special stipulation relating to the burial of pipelines should be clarified to provide that determinations as to the feasibility of burying pipelines shall be made by the Supervisor.

Conclusion and Recommendations

On the basis of our review of the Environmental Impact Statement, we conclude that:

1. Environmental studies of the proposed development area and adjacent areas subject to impacts of OCS development in the development area has not yet produced sufficient information to permit an accurate general analysis of the potential long-term adverse environmental impacts of the proposed development.

2. Virtually no meaningful information has been obtained concerning the level of fishing activity in the areas which are most vulnerable to adverse impact as a result of the proposed OCS development.

3. There has been a general failure to analyze adverse impacts resulting from the proposed development on a cumulative basis in the context of existing and continuing impacts resulting from industrial, agricultural and municipal pollution, habitat degredation and overfishing.

4. There appears to have been little meaningful consultation with other state and federal agencies having fisheries expertise.

5. The Environmental Impact Statement contains little information as to the state of anti-spill technology as it applies to exploration, production and transportation or whether the leases will stipulate that leases must avail themselves of the best available technology as it becomes available.

6. The information contained in the Environmental Impact Statements concerning oil-spill regulations and standards of negligence to be imposed upon lessees is insufficient.

7. Such information as is included in the Environmental Impact Statement concerning OCS Orders and other regulations which govern the conduct of OCS developers permits the inference that such orders and regulations are imprecise.

8. The Environmental Impact Statement contains no general description of shipping traffic or fishing activity in the proposed development area and does not disclose what measures, if any, will be taken to route traffic to avoid the proposed development area.

On the basis of the foregoing conclusions, we recommend

(1) that the proposed lease sale be delayed until the appropriate data has been obtained and appropriate determinations have been made with the benefit of such data and (2) that regulations order and stipulations be promulgated, issued or imposed, as the case may be, so that the cumulative effect thereof is to impose the most rigorous standard of care with respect to oil spills upon all OCS operations.

Very truly yours,

THE NATIONAL COALITION FOR
MARINE CONSERVATION

By________________________________
Christopher M. Weld
Secretary

CMW:cjb

RECEIVED
APR 4 1976
DIVISION OF MINERALS
ENVIRONMENTAL ASSESSMENT

LONG ISLAND ENVIRONMENTAL COUNCIL
95 middle neck road
port washington, n.y. 11050
[516] 883-4725

Claire Stern
Executive Director

BOARD OF DIRECTORS

Dr. A. Harry Brenowitz
Dr. Timothy Costello
Henry Diamond, Esq.
Dr. Martin Garrell
William Ginsberg, Esq.
Terrence Jordan, *Treasurer*
Arthur McManus, *President*
Dr. Joel O'Connor
Nelson Slager
Hon. Herbert Tenzer
Barbara Van Liew

March 1976

COMMENTS ON DRAFT ENVIRONMENTAL STATEMENT FOR OCS SALE # 40
BUREAU OF LAND MANAGEMENT - WASHINGTON, D.C.

Introduction

The Long Island Environmental Council is a coalition of over 100 organizations in Nassau, Suffolk and Queens. Our members live and work in an area that will be directly affected by the OCS accelerated leasing program's sales in the Mid-Atlantic. Although we are aware that the deadline for submitting technical comments on the draft EIS for OCS lease sale #40 has passed, we would like to offer the following statement that highlights our concerns with this EIS, this sale and the PDOD as a whole.

* * * * * *

The federal courts have ruled that an adequate EIS should describe the proposed action and its alternatives in sufficient depth to allow a reasoned choice. The EIS in question does not meet this standard of adequacy. It is lacking in basic data and contains a number of questionable assumptions and unsubstantiated conclusions.

Our first concern is with the gross variations in resource estimates. The projected peak production rate is 90 to 320 thousand barrels of oil and .85

to 3 billion cubic feet of gas per day for a period of 10 years. Without an accurate estimate of the amount of oil and gas to be produced, it is virtually impossible to assess the impact of the accompanying activities. In the section "Summary of Activities Expected to Result from the Sale" the following estimates are given:[1]

rigs	
exploratory	5-20
development	5-20
platforms	10-50
terminal/storage facilities	1-4
onshore operations base	1-4
gas processing plants	3-8
miles pipeline corridor	50-570

The capital investment, employment and acreage that each of these facilities entails are listed in tables III-26 and 27. When these factors are taken into account, the difference between the high and low estimate becomes significant. The EIS states "land use impacts could be substantial if they are not planned for and regulated."[2] The above variations pose a real problem for the planning process.

With the information available, we can only speculate on the use of our natural resources and support facilities that would be required. We therefore conclude that an exploratory program which would provide the public with responsible resource estimates is necessary before a sale is even considered.

The entire treatment of the environmental impact of the proposed operations is distorted by the assumption that the major risk involved is one of an accidental oil spill. The statement concentrated on the probability of an accidental spill but neglected the effect of chronic low level spillage. Chronic pollution affects the capacity of the marine environment to regenerate and cleanse itself. Equal attention should have been given to such problems as the composition and toxicity of formation waters and the persistence of hydrocarbons in ocean sediments

The EIS states that onshore impacts will only be short term because the operation will take place within a finite time period. This is a very short sighted view, for, "ultimately, an economic activity based on a non-renewable resource must confront the predictable end of its existence."[3] The EIS does not address the problem of what we may expect with depletion of resources. Plants built to accommodate peak production will become useless structures when drilling has ended. Land purchases have already begun in anticipation of the sale and may diminish the effectiveness of pending Coastal Zone Management Plan. The EIS ignores and underestimates what we believe to be significant environmental and socio-economic aspects of the sale.

We endorse the statement of the Cape May County Planning Board (New Jersey) which demands recognition of the economic as well as aesthetic importance of the tourist industry. The concerns of the New Jersey officials are also applicable to Long Island's investment in fishing and recreational facilities.

We also endorse the statement of the Natural Resources Defense Council, especially their demand that the EIS quantify the value of wetlands and the impact of their loss. Unless the costs of losses of coastal lands and the impact on the tourist and fishing industries are analyzed, the public cannot understand and evaluate the trade-offs involved. The cumulative impacts of additional sales are only mentioned in passing.[4]

> "Understanding of the complex relationships of the various living and non living components of the marine environment and the effects of OCS oil and gas development are not, in general, sufficient to allow identification of the cumulative impact of additional sales. Even on a sale specific basis, the identification and especially the quantification of these impacts cannot be made with any certainty."

The BLM's response to criticism of the programmatic EIS was that there would be specific data in the site specific EIS. Now the site specific EIS says that basic data for assessment of cumulative impact is lacking. The BLM is admitting to their inability to evaluate the effects of separate or combined sales in the mid-Atlantic. Such evaluations were to be a product of the coastal zone management program of each of the affected states. The BLM does not want to wait for this information to be developed.

A number of unacceptable assumptions are made about the benefits of OCS development. The first is that OCS oil and gas will displace foreign imports, thus reducing the dangers of tanker traffic and furthering the goal of national self-sufficiency without straining existing facilities.

> "If oil from the proposed sale were to be transported by tankers to shore, as opposed to transported via pipeline, it would still be expected to replace foreign crude oil. The volume of crude oil receipts would be the same, regardless of source." 5

Without a national ethic of energy conservation, there is no basis for this assumption.

We commend the BLM for its work on Section VIII C, a comprehensive summary of conservation measures and alternate energy sources. Unfortunately, identification of alternatives is not sufficient; their development must be actively promoted by a national energy policy.[6]

> "Government predictions about future energy demands have the force of self fulfilling prophecy. By sponsoring long term investment to meet expected needs, government policy will reinforce the existing pattern of energy demand."

The accelerated leasing program demands a long-term capital investment which will perpetuate our dependence on fossil fuels. OCS oil and gas development does not constitute a short term solution to our energy problem. Product will not be available for 5 to 7 years by which time research and development of alternatives can be considerably advanced, provided the proper incentives are established by the Congress and the White House.

The petroleum industry has long been accorded a favorable position in the determination of national policy. An alleged benefit of OCS production is that it will cost less than mandatory conservation. In the PROGRAMMATIC PDOD, the cost of extraction of OCS oil is compared to the market price of imported oil. This comparison is obviously invalid, for the expected market price of OCS is never mentioned. It is further stated that :[7]

> "... as long as the total cost per barrel of OCS oil is less than the price of oil, it is better to increase OCS production by one barrel than to conserve an additional barrel through mandatory conservation measures. This is true because the barrel of production has a price (value) in excess of its cost, thus it provides a net savings if it is produced."

When price exceeds cost, the generally accepted name for the result is profit. Will OCS production really provide a net saving to the consumer who will continue to pay the same price for oil and bear the additional environmental costs of its production? Offshore leasing of frontier areas is a boon to the petroleum industry but is not an essential part of the nation's non-existent energy policy. This kind of analysis raises serious questions about the good faith of the Bureau of Land Management and its role as protector of the nation's resources.

The primary goal of NEPA is to improve the process of public decision making in full awareness of our responsibility as trustees of the environment for this and future generations. A well executed EIS is an integral part of this process. Many consider the preparation of an EIS a costly, time-consuming process whose result is of dubious value. Unfortunately, impact statements such as this one only serve to confirm this view. We believe that a well prepared EIS can be an invaluable tool for intelligent planning. We will not permit it to become merely a bureaucratic formality.

The decision to lease must be treated as a policy decision. The role of the EIS is to present information to the public in an objective manner: to describe the proposal, the alternatives, and the trade-offs involved. The decision is then to be made by the public, not by a federal agency and not by private industry. We have and will continue to testify, comment, cajole and finally sue to insure compliance with federal law.

Prepared by Judy Coffin and Claire Stern

March 1976
dbm

FOOTNOTES

1. Draft Environmental Impact Statement. Vol. I, p. 16
2. Draft EIS. Vol. II, p. 227
3. "Issues on the Assessment of Environmental Impacts of Oil and Gas Production on the Outer Continental Shelf." Environmental Studies Board, National Research Council. National Academy of Engineering, Washington, D.C. 1974.
4. Draft EIS. Vol. II, p. 306
5. Draft EIS. Vol II, p. 131
6. Rothschild, "Illusions About Energy". N.Y. Review of Books, August 9, 1973.
7. Programmatic PDOD, p. 11

8. Public Hearing Log

PUBLIC HEARING
for
Draft Environmental Statement
on

PROPOSED OUTER CONTINENTAL SHELF OIL AND GAS LEASE SALE
OFFSHORE MID-ATLANTIC STATES
(OCS SALE #40)

held by the
U.S. Department of the Interior
in
Atlantic City, New Jersey

January 27-30, 1976

WITNESS LIST

(Testimony Given in This Order)

Tuesday, January 27, 1976

	NAME	ORGANIZATION REPRESENTED
1.	Brendan T. Byrne	Governor, State of New Jersey
2.	Simon F. McHugh	Executive Assistant, Office of the Governor, State of Maryland
3.	Robert Jordan	State of Delaware, State Geologist
4.	Charles J. DiBona	Executive Vice President, American Petroleum Institute
5.	Frank J. Dodd	President, New Jersey State Senate District 26 (Essex)
6.	Steven Levy	New Jersey State Beach Erosion Commission, Wayside, New Jersey
7.	Herbert J. Buehler	New Jersey State Senator, District 2 (Monmouth)
8.	Dean F. Bumpus	American Petroleum Institute (Woods Hole Oceanographic Institution, Senior Scientist)
9.	Eugene H. Luntey	American Gas Association/Brooklyn Union Gas Company, New York, President

10.	William J. Miners	New Jersey Gas Association
11.	Theodore W. Ryan	President, Building Trades Council of Delaware
12.	Elwood Jarmer	Board of Chosen Freeholders and County Planning Board, Cape May County, New Jersey
13.	Joseph J. Zedrosser	Representing Louis J. Lefkowitz, Attorney General of the State of New York
14.	William E. Wenstrom	American Petroleum Institute (Woodward-Clyde Consultants)
15.	Thomas A. Griffin, Jr.	New York Gas Group/Orange and Rockland Utilities, Inc., Spring Valley, New York
16.	W. J. Bowen	Interstate Natural Gas Association of America (President and Chief Exec. Officer, Transcontinental Gas Pipeline Corporation)
17.	Merle W. Arr	Interstate Natural Gas Association of America (Natural Gas Pipeline Company of America, Manager of Environmental Affairs)
18.	David K. Galtney	American Association of Petroleum Landsmen (Chairman, Outer Continental Shelf Committee)
19.	Robert W. Welch, Jr.	Columbia Gas System Service Corporation (Vice President, Environmental Affairs) Wilmington, Delaware
20.	Francis Beinecke	Natural Resources Defense Council, New York (Attorney/Land Use Planner)
21.	Harold P. Abrams	President, Atlantic County Citizens Council on Environment, Margate, New Jersey
22.	George A. Clark	Citizens Association for the Protection of the Environment, Cape May County, New Jersey
23.	John T. Clary	Chairman, Committee for Environmental Affairs of the Delaware Valley Council, Philadelphia, Pennsylvania

24.	J. Herbert Dahm, Jr.	President, Rockland County Association, Inc., Nanuet, New York
25.	Harold E. Rudel	Manager, Land and External Affairs, Sun Oil Company
26.	Bill McKenna	Representing William O'Connell, Director, Political Action Committee, Local 825, Operating Engineers, AFL-CIO
27.	George C. Grow	American Association of Petroleum Geologists
28.	Gerard A. Dengel	International Union of Operating Engineers, Eastern District
29.	Martin B. Brilliant	The Committee For a Better Environment
30.	E. J. Langhetee, Jr.	The Louisiana Land and Exploration Company
31.	John B. Boniface	Private Citizen, Chatham, New Jersey
32.	David Satinover	President, Atlantic Home Builders Association of New Jersey
33.	Evan R. Spalt	Honorary Chairman, New York Board of Trade
34.	James L. McDonald	Commander, U.S. Coast Guard, Governors Island, New York

Wednesday, January 28, 1976

1.	William J. Hughes	Representative, 2nd Congressional District, New Jersey, U.S. House of Representatives
2.	William Tavoulareas	American Petroleum Institute (President, Mobil Oil Corporation)
3.	Frank Young	American Petroleum Institute (Director, Economics Division, Continental Oil Company)
4.	Charles D. Worthington	County Executive, Atlantic County, New Jersey
5.	Angelo J. Errichetti	Mayor, City of Camden, New Jersey
6.	Charles Goodman	Mayor, Township of Long Beach, Beach Haven, New Jersey
7.	Guy F. Muziani	Mayor, City of Wildwood, New Jersey
8.	Earle H. O'Donnell	Attorney, United Distribution Company, Bethesda, Maryland
9.	Robert Kent	Freeholders Association of Monmouth County, New Jersey
10.	Francis E. Robbins	New York State Highway Users Conference/ New York State Grange
11.	Herod E. McLeod	Private Citizen (Free lance editor/ commentator)
12.	Daryl F. Todd	Atlantic County Board of Freeholders
13.	Henry H. Reichner	Executive Director, The Penjerdel Corporation/Greater Philadelphia Chamber of Commerce
14.	Steven L. Gordon	Representing Hugh L. Carey, Governor of State of New York, and Ogden Reid, Commissioner of the New York State Department of Environmental Conservation
15.	Robert A. Low	New York City Environmental Protection Administration
16.	Grace Pierce	Watch Our Waterways/Save Our Seashores
17.	Jerry Shields	The Wilderness Society

18.	William O'Connell	Director, Political Action Committee, Local 825, Operating Eingineers, AFL-CIO
19.	Earnest Buhr	Director, Ocean County Board of Chosen Freeholders
20.	Kenneth H. Crandell	American Petroleum Institute (Consulting Professor, Stanford University)
21.	John L. Loftis, Jr.	American Petroleum Institute (Senior Vice President, Exxon Company, U.S.A.)
22.	Colin P. Summerhayes	American Petroleum Institute
23.	James C. Smith	Dresser Industries, Inc. (President, Petroleum Equipment Division)
24.	Harry R. Patton	The Greater Salisbury Committee, Inc. (Vice-Chairman), Sailsbury, Maryland
25.	Louis J. Dalberth	Director, Southern New Jersey Development Council
26.	Joseph J. Polillo	President, Chelsea Heights Civic Association, Atlantic City, New Jersey
27.	Robert J. Johnson	Chairman, Highway Users Council of Western New York
28.	Charles D. Matthews	President, National Ocean Industries Association, Washington, D.C.
29.	Eneas D. Kane	Vice President, Standard Oil Company of California
30.	Ronald Price	New Jersey Sportsmen-Industry Conservation Council
31.	Bernard Gordon	Lakeland Economic Area and Development Council, Rockaway, New Jersey
32.	Kenneth E. Pyle	Manager, Commercial and Industrial Department, Atlantic City Electric Company
33.	Roger D. Stanwood	Vice President-Gas Supply, Transcontinental Gas Pipe Line Corporation

34.	Ann Platt	National Parks and Conservation Association
35.	R. Warren Sexton	American Petroleum Institute (SEDCO, Inc.)
36.	Lloyd Otteman	American Petroleum Institute (Shell Oil Company)
37.	Lawrence Boston	American Petroleum Institute (J. Ray McDermott & Co., Inc.)
38.	Harold E. Berg	Executive Vice President and Chief Operating Officer, Getty Oil Company, Los Angeles, California
39.	Joe B. Alford	Executive Director, American Institute of Mining, Metallurgical & Petroleum Engineers
40.	Richard H. Bowerman	New England Gas Association/Southern Connecticut Gas Company/Associated Gas Distributors
41.	James Mullarkey	Chairman, Board of Directors, New York State Conservation Council, Inc.
42.	Arnold Lapiner	Marine Environmental Council of Long Island, Seaford, New York
43.	John M. Hunt	American Petroleum Institute (Senior Scientist, Woods Hole Oceanographic Institution)
44.	Clayton D. McAuliffe	American Petroleum Institute (Senior Research Associate, Chevron Oil Field Research Co.)
45.	John A. Rogge	Mayor, City of Brigantine, New Jersey
46.	James W. Dunlop	Assistant Vice President, Brooklyn Union Gas Company
47.	W. N. Plamondon, Jr.	International Association of Drilling Contractors
48.	Roger Hansen	Executive Vice President, Ole Hansen and Sons, Inc., Pleasantville, New Jersey
49.	Raymond P. Cullen	Operations Manager, Copter, Inc. Philadelphia, Pennsylvania

50.	Richard H. Demmy	UGI Corporation, Valley Forge, Pennsylvania
51.	George Hagemeister	Chairman, New Jersey Highway Users Conference
52.	Steven Levy	Citizens Energy Coalition of New Jersey
53.	Floyd C. Cole	Senior Vice President, Orange and Rockland Utilities, Inc., Spring Valley, New York
54.	D. W. Bennett	Executive Director, American Littoral Society, Highlands, New Jersey

Thursday, January 29, 1976

1.	Charles Guhr	Mayor, Borough of Wildwood Crest, New Jersey
2.	Leo Sterenberg	Cape May County Chamber of Commerce
3.	George Liggett	Past President, Natural Food Association
4.	Herman H. Holloway, Sr.	Delaware State Senator, 2nd District
5.	Robert H. Nanz	Shell Oil Company (Vice President, Exploration and Production)
6.	O. J. Shirley	Chairman, Clean Atlantic Associates
7.	Richard P. Zingula	Exxon Company, USA (Senior Geologist)
8.	Edward W. Mertens	American Petroleum Institute (Senior Research Associate, Chevron Research Company)
9.	Joseph P. King	Chairman, Genesee Finger Lakes Highway Users Council, Rochester, New York
10.	Stuart C. Mut	Vice President, Atlantic Richfield Company
11.	Steven J. Batzer	President, Harland, Inc., New Jersey Philadelphia, Pennsylvania
12.	Paul Felton	Water Resources Association of the Delaware River Basin
13.	Laurence R. Smith	Assistant Vice President, Staten Island (New York) Chamber of Commerce
14.	George F. Polzer, Jr.	Chairman, Chemical Industry Council of New Jersey, Trenton, New Jersey
15.	Lewis R. Applegate	Governmental Relations Director, New Jersey State Chamber of Commerce
16.	John G. Winger	The Chase Manhattan Bank, N.A. (Vice President and Division Executive, Energy Economics Division)
17.	Joseph F. Bradway, Jr.	Mayor, Atlantic City, New Jersey

18.	William D. Swan, Jr.	Executive Director, Association For a Better New York
19.	William C. Lunsford, Jr.	Zapata Haynie Corporation, Baltimore, Maryland
20.	Mrs. Ernie A. Honig	Maryland State Chamber of Commerce
21.	James T. Dresher	Representing E. H. Clark, Jr., President, Baker Oil Tools, Inc. Los Angeles, California
22.	John J. Pershing, Jr.	Economic Consultant
23.	Matthew C. Cordaro	Manager, Environmental Engineering, Long Island Lighting Company
24.	H. Willis Jackson	Chairman, Joint Executive Committee for the Improvement and Development of the Philadelphia Port Area
25.	William A. Harrison	Secretary, Philadelphia Maritime Exchange
26.	Andrea Lippi	Andrea Lippi Productions
27.	Donald E. Cotten	Sierra Club, OCS Coordinator for the Northeast Regional Conservation Committee
28.	Donald L. Smith	Private Citizen
29.	George M. Whiteside, III	Whiteside, Moeckel and Carbonell, Inc. Wilmington, Delaware
30.	Charles H. Howard	President, Sussex County Board of Realtors, Rehoboth Beach, Delaware
31.	Dudley L. Willis	Vice President, Edward H. Richardson Associates, Inc., Newark, Delaware
32.	Ross E. Anderson, Jr.	President, Delaware State Chamber of Commerce
33.	John H. Maddocks	Vice President, New Jersey Industrial Development Association, Newark, New Jersey
34.	Thomas H. Kingsland	Atlantic County Alliances of Chambers of Commerce, New Jersey

35.	Charles E. Wille	Member, Board of Directors, New York State Farm Bureau
36.	William McKenna	Local 825, Operating Engineers, AFL-CIO
37.	Michael Klosek	Local 825, Operating Engineers, AFL-CIO
38.	Thomas Sherlock	Local 825, Operating Engineers, AFL-CIO, Little Falls, New Jersey
39.	Thomas Conroy	Local 825, Operating Engineers, AFL-CIO
40.	Frank DiFelice	Local 825, Operating Engineers, AFL-CIO
41.	Thomas Greer	Local 825, Operating Engineers, AFL-CIO
42.	James Ward	Local 825, Operating Engineers, AFL-CIO
43.	William Beren	Legislative Agent, The League for Conservation Legislation, Teaneck, New Jersey
44.	Ruth Fisher	Sun People Alternate Energy Advocates
45.	Helen Sciarra	Private Citizen, Cape May County, New Jersey
46.	Mary Atkinson	Private Citizen, Wildwood Crest, New Jersey

Friday, January 30, 1976

1.	Lawrence M. Smith	Larry Smith Electronics, Inc., Absecon, New Jersey
2.	Constance Barry	Private Citizen, Ventnor, New Jersey
3.	Peter Luciana, Jr.	Private Citizen

9. Written Comments Log

LIST OF WRITTEN COMMENTS

received on

Draft Environmental Statement
on

PROPOSED OUTER CONTINENTAL SHELF OIL AND GAS LEASE SALE
OFFSHORE MID-ATLANTIC STATES
(OCS SALE #40)

Date of Comments	Name	Organization Represented
1/29/76	Director	U.S. Geological Survey
2/9/76	Director	U.S. Fish and Wildlife Service
2/10/76	Director	Bureau of Mines
1/27/76	Director	Bureau of Outdoor Recreation
1/20/76	Director	National Park Service
12/22/75	Daniel R. Muller	Nuclear Regulatory Commission
2/6/76	Sidney R. Galler	Department of Commerce (NOAA)
2/13/76	Roger W. Sant	Federal Energy Administration
2/6/76	John R. Hill, Jr.	Department of Army, Corps of Engineers
2/12/76	Rebecca Hanmer	Environmental Protection Agency
3/16/76	W. H. Pennington	Energy Research and Development Administration
2/27/76	Rebecca Hanmer	Environmental Protection Agency
2/11/76	Gerald M. Hansler	Regional Administrator, EPA, Region II, New York, New York
3/24/76	D. J. Riley	U.S. Coast Guard, Department of Transportation, Washington, D.C.
4/2/76	James E. Robbins	National Aeronautics and Space Administration, Wallops Flight Center
4/14/76	Cesar DeLeon	Materials Transportation Bureau, Department of Transportation

2/17/76	Joseph J. Zedrosser	Assistant Attorney General, Department of Law, State of New York, Albany, New York
2/20/76	Stephen L. Gordon	Deputy Commissioner, New York State Department of Environmental Conservation, Albany, New York
3/11/76	Paul J. Merges	Energy Systems Specialist, Office of Environmental Analysis, New York State Department of Environmental Conservation
2/5/76	Vladimir Wahbe	Secretary of State Planning, State of Maryland, Baltimore, MD
2/16/76	Simon F. McHugh, Jr.	Executive Assistant, State of Maryland, Annapolis, Maryland
2/24/76	Gerald P. McCarthy	Administrator, Council on the Environment, Commonwealth of Virginia, Richmond, Virginia
1/27/76	David J. Bardin	Commissioner, Department of Environmental Protection, State of New Jersey, Trenton, NJ
2/11/76	John V. N. Klein	County Executive, Suffolk County, Long Island, New York
1/2/76	James J. Howard	U.S. House of Representatives, New Jersey
1/2/76	A. C. Herbert	for Edwin W. Parkinson, Chairman, Pennsylvania Highway Users Conference, Harrisburg, PA
1/5/76	George Wm. Graham	President, Schenectady County Chamber of Commerce, Inc., NY
1/9/76	Roger W. Johnson	Exec. Vice Pres., Woodbridge Metropolitan Chamber of Commerce, Woodbridge, New Jersey
1/12/76	David F. Hansen	President, Pennsylvania Gas and Water Company, Wilkes-Barre, PA
1/12/76	Martin L. Gable	Private Citizen, Scottsbluff, Nebraska
1/12/76	A. J. Kuntz	Private Citizen, Cherry Hill, New Jersey

1/14/76	Oscar D. Summers	Attorney at Law, Oyster Bay, New York
1/14/76	Robert F. Lenhart	Vice President, Administration, Committee for Economic Development, Washington, D.C.
1/15/76	Robert K. Nein	Scott Insurance, James A. Scott & Son, Inc., Lynchburg, VA
1/15/76	L. Graham Haynie, Jr.	Davis and Stephenson, Inc., Insurance, Roanoke, VA
1/15/76	John M. Williams	Manager of Energy Supply, Illinois Power Company
1/15/76	A. G. Moffett	Director, Program Development & Field Service, Virginia Farm Bureau Federation, Richmond, VA
1/15/76	John R. Booten	Sr. Vice Pres., Wiley & Wilson, Inc., Richmond, Virginia
1/15/76	Carl A. Orechio	New Jersey State Assemblyman, District 27 (Essex)
1/16/76	John E. Sim	Morgan-Marrow Company Insurance, Hampton, Virginia
1/16/76	J. Powell Watson, Jr.	Burroughs & Watson, Inc., Insurance Norfolk, Virginia
1/19/76	Jack I. Matthews	Exec. Sec.-Treas., Maryland Farm Bureau, Inc., Randallstown, MD
1/19/76	Kenneth A. Gibson	Mayor, Newark, New Jersey
1/19/76	Charles M. Morrison	Private Citizen, Richmond, VA
1/19/76	J. Cullen Weadock	President, Chesapeake and Potomac Airways, Inc., Baltimore, MD
1/20/76	Joseph W. Dalton, Jr.	Exec. Vice Pres., The Greater Saratoga Chamber of Commerce, Saratoga Springs, New York
1/20/76	Frank D. Hargrove	President, A. W. Hargrove Insurance Agency, Inc., Glen Allen, VA
1/21/76	John H. Ewing	New Jersey State Assemblyman, District 16 (Somerset-Hunterdon-Morris)
1/21/76	Ernest F. Schuck	New Jersey State Assemblyman, District 5 (Camden)

1/22/76	L. L. Sargent	Tenneco Oil, Houston, Texas (Exploration Manager, No. Amer.)
1/22/76	Vincent McMahon	Private Citizen, Villas, New Jersey
1/22/76	Anthony D. Lombardo	President, Greater Troy Chamber of Commerce, Troy, New York
1/22/76	Albert A. Poppiti	Exec. Vice Pres., Delaware Contractors Association, Wilmington, Delaware
1/23/76	June Lindstedt Siva	Science Advisor, Environmental Protection, Governmental and Environmental Affairs Division, Atlantic Richfield Company, Los Angeles, California
1/23/76	Carl A. Jentzen	Mill Manager, Westvaco, Covington, Virginia
1/26/76	Robert S. Henserson	Private Citizen, Norfolk, VA
1/26/76	Howard W. Nickerson	Exec. Sec., New England Fisheries Steering Committee, New Bedford, Massachusetts
1/26/76	Samuel M. Schellenger	President, The Pilots' Association for the Bay and River Delaware, Philadelphia, PA
1/27/76	C. F. Logan	Vice Pres., Central Illinois Public Service Company, Springfield, ILL
1/27/76	John M. Brown	President, Pennsylvania Gas Association, Harrisburg, PA
1/27/76	Arthur R. Seder, Jr.	President, American Natural Gas Company, Detroit, Michigan
1/27/76	S. J. Schulman	President, Westchester County Association, Inc., White Plains, NY
1/26/76	James H. Harwell	Exec. Dir., Texas Industrial Commission
1/26/76	Donald W. Dobson	Exec. Vice Pres., Greater Colonie Chamber of Commerce, Colonie, NY
1/27/76	Robert H. Holder	Vice Pres. & Chief Eng., Wisconsin Gas Company, Milwaukee, Wisc.
1/27/76	Richard J. Murdy	Vice Pres. & Gen. Mgr., CNG Producing Company, Clarksburg, WVA

1/27/76	Leonard Braun	Vice Pres. for Regional Improvement, Long Island Association of Commerce and Industry, Jericho, NY
1/27/76	Thomas E. Huzzey	Commissioner of Oil and Gas Conservation Commission, State of West Virginia
1/27/76	H. Earl Fullilove	Chairman, Board of Governors, Building Trades Employers' Association, New York, NY
1/27/76	Thomas N. Stainback	President, New York Chamber of Commerce and Industry, New York, New York
1/27/76	Theodore C. Southworth	President, Albany Area Chamber of Commerce, NY
1/27/76	Irvin J. Good	Exec. Dir., Philadelphia Port Corporation, PA
1/27/76	Dean F. Bumpus	Senior Scientist, Woods Hole Oceanographic Institution (for American Petroleum Institute)
1/27/76	William E. Wenstrom	American Petroleum Institute (Woodward-Clyde Consultants)
1/27/76	John B. Boniface	Private Citizen, Chatham, NJ
1/28/76	Frank Young	American Petroleum Institute (Director, Economics Div., Continental Oil Company)
1/28/76	Kenneth H. Crandall	American Petroleum Institute (Professor, Stanford Univ.)
1/28/76	K. O. Emery	American Petroleum Institute (Sr. Scientist, Woods Hole Oceanographic Institution)
1/28/76	Lloyd Otteman	American Petroluem Institute (Shell Oil Company)
1/28/76	Lawrence A. Boston	American Petroleum Institute (J. Ray McDermott & Co., Inc.)
1/28/76	John J. Brown	President, Society for Environmental Economic Development, Trenton, NJ
1/28/76	Steven Levy	Secretary, Citizens Energy Coalition (of New Jersey)

1/28/76	Herbert M. Packer	Exec. Vice Pres., Pennsylvania Builders Association, Harrisburg, Pennsylvania
1/28/76	Thomas L. Kimball	Exec. Vice Pres., National Wildlife Federation, Washington, D.C.
1/28/76	Elmer C. Easton, P.E.	Private Citizen, New Brunswick, New Jersey
1/28/76	-----	South Carolina Electric & Gas Company
1/28/76	Clarence F. Dicks	Chairman, Cumberland County Economic Development Commission, New Jersey
1/28/76	William V. Bell	Sr. Vice Pres., Indiana Gas Co. and Central Indiana Gas Co.
1/28/76	Paul E. McClellan	Director of Accounting, Citizens Gas & Coke Utility, Indianapolis, Indiana
1/28/76	J. B. Simpson	Exec. Vice Pres., Consumers Power Company, Michigan
1/28/76	L. Raymond Billett	Asst. Vice Pres., Supply, Northern Illinois Gas Company
1/28/76	-----	New Jersey Motor Truck Association
1/28/76	William W. Kay	Pennsylvania Society of Professional Engineers, Harrisburg, PA
1/28/76	William A. Gemmel	President, South Jersey Gas Company
1/28/76	Charles H. Marciante	President, New Jersey State AFL-CIO
1/28/76	Samuel Schwartz	Sr. Vice Pres., Corporate Planning, Continental Oil Company
1/28/76	Nancy Maynard	American Petroleum Institute (Research Fellow, Dept. of Applied Chemistry, Harvard University)
1/28/76	Philip B. Stanton	American Petroleum Institute (Wildlife Rehabilitation Center, Upton, Massachusetts)
1/28/76	Robert L. Kiley	Salisbury Wicomico Economic Development Corp, Salisbury, MD
1/28/76	L. C. Soileau, III	Pres., Chevron Oil Company, California Company Division

1/28/76	Harry M. Karavan	Vice Pres., Wildwood Civic Betterment Association, NJ
1/28/76	Eugene D. Bookhammer	Lieutenant Governor, State of Delaware
1/28/76	Anthony S. Esposito	Empire State Chamber of Commerce, Albany, New York
1/29/76	Bernard J. Kennedy	Vice Pres. & Gen. Counsel, National Fuel Gas Company
1/29/76	John Crandall	Exec. Director, Gloucester County Development Council Inc., Sewell, NJ
1/29/76	John C. Stoneman	Exec. Vice Pres., Commonwealth Gas Company
1/29/76	Ed Bennett	Bennett Development Co.
1/29/76	David R. Chittick	Chairman, Energy Council, New Jersey Manufacturers Assoc., Newark, NJ
1/29/76	-----	Energy Action Committee, Washington, D.C.
1/29/76	Eugene F. Deutsch	Director of Purchasing, United States Metals Refining Co., Carteret, NJ
1/30/76	William D. Douglass	Private Citizen, Farmingdale, NY
1/30/76	-----	Monmouth County Environmental Council, Freehold, New Jersey
1/31/76	Harry D. Greiner	Private Citizen, Wildwood Crest, NJ
1/31/76	Robert V. Goordman	Private Citizen, Hackettstown, New Jersey
1/31/76	Robert J. Eckert & Richard V. Kelly	Committee Against Oilports On the Bayshore, Middletown, NJ
2/2/76	Elizabeth Parker	Private Citizen, Charleston, South Carolina
2/2/76	J. Millard Tawes	Private Citizen, Crisfield, MD
2/4/76	-----	Cumberland County, New Jersey, Planning Board
2/4/76	Arthur J. Santoianni	Grand Counselor, New York State, United Commercial Travelers of America

2/5/76	Worth D. Holder	Exec. Vice Pres., Rochester Area Chamber of Commerce, Inc., NY
2/5/76	J. D. Sinclair	Chairman, The Committee For A Better Environment, Inc., Holmdel, New Jersey
2/5/76	Robert I. Smith	President, Public Service Electric and Gas Company, Newark, NJ
2/6/76	Joseph C. Domino	President, New Orleans Area Chamber of Commerce, LA
2/6/76	James F. Hastings	President, Associated Industries of New York State, Inc., Albany, NY
2/6/76	M. F. Gavet	Vice Pres., Gas Operations, Philadelphia Electric Company, PA
2/6/76	Harry R. Belinger	City Rep. & Dir. of Commerce, City of Philadelphia, PA
2/6/76	C. E. Golay	Chairman, Offshore Operators Committee, New Orleans, LA
2/10/76	Marcie Bierlein	President, League of Women Voters of Delaware, Wilmington, DEL
2/10/76	-----	American Lung Association of Southern New Jersey, Hammonton, NJ
2/10/76	John R. Pitzer	President, Pennsylvania Farmers' Association, Camp Hill, PA
2/10/76	J. Fike Godfrey	Exec. Vice Pres., West Texas Chamber of Commerce, Abilene, TEX
2/10/76	Pledger B. Cate, Jr.	Exec. Vice Pres., South Texas Chamber of Commerce, San Antonio
2/10/76	Edward A. McNamara	President, NEDCO
2/10/76	Robert Hibbard	Exec. Dir., Pennsylvania Chamber of Commerce, Harrisburg, PA
2/10/76	Lawrence J. Ogden	Director, Construction & Operations, Interstate Natural Gas Association of America
2/9/76	R. J. Judah	Director, Environmental & Industry Affairs, Transcontinental Gas Pipe Line Corporation, Houston, TEX
2/9/76	Roman J. Birchler	Mayor, Borough of Lavallette, Ocean County, NJ

2/9/76	Stanley Ragone	Exec. Vice Pres., Virginia Electric And Power Company, Richmond, VA
2/10/76	R. B. Rice	Pres., Society of Exploration Geophysicists
2/10/76	Harry A. Paynter	Pres., Gas Appliance Manufacturers Association, Arlington, VA
2/10/76	Edward J. McLane	Business Administrator for Borough Council, Borough of Keyport, New Jersey
2/10/76	Norbert P. Psuty	Director, Marine Sciences Center, Rutgers University
2/10/76	Frank R. Jones	Deputy Supervisor, Islip, New York
2/10/76	Jack S. Blanton	Texas Mid-Continent Oil & Gas Association, Dallas, Texas
2/10/76	Ben Ramsey	Chairman, Railroad Commission of Texas, Austin, Texas
2/10/76	Edward W. Livingston	Assistant to Vice President, Consolidated Edison Company of New York, Inc.
2/11/76	Richard K. Olsson	Professor, Dept. of Geology, Rutgers University
2/11/76	James R. Hurley	New Jersey State Assemblyman District 1 (Cape May-Cumberland)
2/11/76	Richard H. Demmy	Vice Pres., Public Affairs, UGI Corporation, Valley Forge, PA
2/11/76	Douglas S. Powell	Director of County Planning, Middlesex County Planning Board, New Brunswick, New Jersey
2/11/76	John H. McDermitt	Counsellor at Law, Paterson, New Jersey
2/12/76	Robert W. Welch, Jr.	Vice Pres., Environmental Affairs, Columbia Gas System Service Corp., Wilmington, Delaware
2/12/76	Peter G. Gray	President, The New Orleans Geological Society, Inc,, LA
2/12/76	James J. Howard	U.S. House of Representatives, 3rd District, New Jersey

2/12/76	J. M. Otts, Jr.	Gulf Energy and Minerals Company, U.S., Houston, Texas
2/12/76	Crandall D. Jones	Manager, Exploration Department, Exxon Company, U.S.A., Houston
2/12/76	W. H. Baker	Manager, Environmental Affairs & Safety Dept., Skelly Oil Company, Tulsa, OKLA
2/12/76	Salvatore Quaranta	Exec. Vice Pres., Mount Vernon Chamber of Commerce, NY
2/13/76	David H. Treichler	Director, Government Relations, Broome County Chamber of Commerce, Binghamton, NY
2/13/76	John Picciano	Counsel for the Planning Department, (for Ralph G. Caso, Co. Exec.) Nassau County Planning Commission, State of New York
2/13/76	Eric Konefal	Energy Information, Joint Energy Task Force, Rome Area Chamber of Commerce, Utica/Rome, NY
2/13/76	-----	The Automobile Club of Western New York
2/16/76	Edwin Kirk	Private Citizen, Philadelphia, PA
2/16/76	Edwin B. Forsythe	U.S. House of Representatives, New Jersey
2/17/76	Herman Loeb	Director of Exploration, Environmental Affairs, Pennzoil Company, Houston, Texas
2/17/76	Christopher M. Weld	Secretary, National Coalition for Marine Conservation, Inc., Boston, Massachusetts
2/17/76	Frances Beinecke	Natural Resources Defense Council, Inc., New York, New York
2/18/76	R. L. Ferris	Vice Pres., Exploration & Production, Southern Region, Shell Oil Company, New Orleans, LA
2/18/76	George E. Tompkins	Mayor, Borough of Seaside Heights, New Jersey
2/19/76	J. Richard Lucas	Mining Consultant and Engineer, Virginia Polytechnic Institute

3/4/76	Jay Weidman	Chairman, Environmental Improvement Committee, The Penjerdel Corporation, Philadelphia, PA
3/10/76	Victoria M. L. Potter	Chairman, Governor's OCS Advisory Task Force, State of Rhode Island
2/12/76	Elwood Jarmer	Cape May County Planning Board, NJ
2/11/76	Irving Like	Special Counsel to County of Suffolk, New York
-----	Anonymous	Private Citizen (Delaware)
3/ /76	-----	Long Island Environmental Council, Port Washington, New York
3/31/76 (1/28/76)	Lawrence Schmidt (for Mrs. Warren Zapp)	Ban-the Tank-Coalition Jersey City, New Jersey

BIBLIOGRAPHY

Accomack-Northampton (Virginia) Planning District Commission Land Use Report for Planning District #22. 1973. Accomack, Virginia. 78 p.

Adelman, Morris. 1972. Long-Run Cost Trends: Persian Gulf and the United States. *In* Balancing supply and demand for energy in the United States. Rocky Mountain Petroleum Institute, U. Denver.

Adelman, Morris. The world petroleum market. 1974. Johns Hopkins University Press. Baltimore, Maryland.

Ahern, William R., Jr. 1973. Oil and the outer coastal shelf. Ballinger Publishing Company, Cambridge, Massachusetts.

Alaka, M. A. 1968. Climatology of Atlantic tropical storms and hurricanes. ESSA Tech. Rept. WB-6. 18 p.

Alaska, State of. 1971. Comments on the proposed trans-Alaska pipeline. U. S. Department of the Interior, July 30, 1971. 192 p.

Allen, O. 1974. Personal communication. Los Angeles OCS Office, Bureau of Land Management, Department of the Interior.

Almon, Clopper, Jr., et al. 1974. 1985: Interindustry forecasts of the American economy. D. C. Heath, Lexington, Massachusetts.

Alofs, D. J. and R. L. Reisbig. 1972. An experimental evaluation of oil slick movement caused by waves. J. Phys. Oceanogr. 2(4): 439-443.

Alpine Geophysical Associates. 1974. Final report. Geophysical investigation of Atlantic generating station site and offshore region for Public Service Electric and Gas Company, Newark, New Jersey. Alpine Geophysical Associates, Inc., Norwood, New Jersey.

American Petroleum Institute. November 1971. Joint association survey, 1970. Washington, D. C. American Petroleum Institute.

American Petroleum Institute. 1971. Petroleum facts and figures, 1971. Port City Press, Baltimore Maryland.

Analysis of New York State Motorboat Registrations, 1970-1971. May 1973. Office of Parks and Recreation, New York State Department of Environmental Conservation. Albany, New York.

Anderson, H. R. 1968. Geology and ground water resources of the Rahway area, New Jersey. Spec. Report 27. New Jersey Department of Conservation and Economic Development. Trenton, New Jersey. 72 p., 2 pl.

Anderson, H. R., and C. A. Appel. 1969. Geology and ground water resources of Ocean County, New Jersey. Special Report No. 29. New Jersey Department of Environmental Protection. Trenton, New Jersey. 93 p., 2 pl.

Anderson, J. W. 1973. Uptake and depuration of specific hydrocarbons from oil by the bivalves *Rangia cuneata* and *Crassostrea virginica*. *In* A workshop on inputs, fates and effects of petroleum in the marine environment. Vol. II. National Academy of Sciences, Washington, D. C.

Anderson, J. W. (ed.). 1975. Laboratory studies of the effects of oil on marine organisms: an overview. API Publication No. 4249. Division of Environmental Affairs, American Petroleum Institute. 70 p.

Anderson, J. W., J. M. Neff, B. A. Cox, H. E. Tatem and G. M. Hightower. 1973. The effects of oils on estuarine animals: toxicity, uptake, depuration, and respiration. *In* Effects of pollutants on the physiological ecology of estuarine organisms. U. South Carolina.

Anonymous. 1972. Atlantic fleet operating areas within the eastern sea frontier. Comeastseafron Instruction 3120.5C. Headquarters, Commander Eastern Sea Frontier, New York, New York. 134 p.

Arvidson, L. 1974. Food habits of demersal fish of the northwest Atlantic. Abstracts of fishery papers. 1974 Northeast Fish and Wildlife Conference.

Atlantic Strike Team Equipment List. 1974. Atlantic Strike Team. Elizabeth, North Carolina. 21 p.

Austin, H. M., and P. M. Stoops. 1973. A synoptic study of the surface waters of Block Island Sound and surrounding waters. Part II. Zooplankton. New York Ocean Sci. Lab. Tech. Report No. 0024. 25 p.

Baird, F. T. 1967. The sea scallop (Pecten magellanicus). Maine Department, Sea and Shore Fisheries, Fisheries Education Series 2: 1-11.

Baker, B.B. Jr., W. R. Deebel and R. D. Geisenderfer (eds.). 1966. Glossary of Oceanographic terms. Spec. Pub. 35. U. S. Naval Oceanographic Office, Washington, D. C. 204 p.

Baker, J. M. 1970. The effects of oil on plants. Environ. Poll. 1:27-44.

Baker, J. M. 1971a. Successive spillages. In Cowell (ed.) Proceedings of the symposium on the ecological effects of oil pollution on littoral communities, 30 November-1 December, 1970. Institute of Petroleum, London.

Baker, J. M. 1971b. Oil and salt marsh soil. In Cowell (ed.) Proceedings of the symposium on the ecological effects of oil pollution on littoral communities, 30 November-1 December, 1970. Institute of Petroleum, London.

Baker, J. M. 1971c. Growth stimulation following oil pollution. In Cowell (ed.) Proceedings of the symposium on the ecological effects of oil pollution on littoral communities, 30 November-1 December, 1970. Institute of Petroleum, London.

Baker, J. M. 1971d. Refinery effluent. In Cowell (ed.) Proceedings of the symposium on the ecological effects of oil pollution on littoral communities, 30 November-1 December 1970. Institute of Petroleum, London.

Barghoorn, E. S. 1953. Recent changes in sea level along the New England coast: new archeological evidence. Science 117: 597-598.

Barlow, J. P. 1956. Effect of wind on salinity distribution in an estuary. J. Mar. Res. 15 (3): 193-203.

Barlow, J. P. and M. A. Stafford. 1968. Organic production in Moriches Bay, New York. p. 497-513. In Jackson, D. F. (ed.) Algae, man and environment, Syracuse Univ. Press. 554 p.

Berger, K. J. 1975. Oceanic circulation in the New York Bight, unpub. 26 p.

Berridge, S. A., M. T. Thew and A. G. Loriston-Clarke. 1968. The formation and stability of emulsions of water in crude petroleum and similar stocks. J. of Institute of Petroleum. Vol. 54. p. 333-357.

Berridge, S. A., R. A. Dean, R. G. Fallows and A. Fish. 1968. The properties of persistent oils at sea. J. of the Institute of Petroleum. Vol. 54. p. 300-309.

Bigelow, H. B. 1915. Exploration of the coast water between Nova Scotia and Chesapeake Bay, July and August, 1913, by the U. S. Fisheries schooner Grampus. Oceanography and plankton. Bull. Mus. Comp. Zool. 59 (4): 149-359.

Bigelow, H. B. 1917. Exploration of the coast water between Cape Cod and Halifax in 1914 and 1915, by the U. S. Fisheries schooner Grampus. Oceanography and plankton. Bull. Mus. Comp. Zool. 61 (8): 161-357.

Bigelow, H. B. 1933. Studies of the waters on the continental shelf Cape Cod to Chesapeake Bay. Part I. The cycle of temperature. Pap. Phys. Oceanog. 2 (4). 135 p.

Bigelow, H. B. and W. Schroeder. 1953. Fishes of the Gulf of Maine. U. S. Fish and Wildlife Service Fish. Bull. 53 (74). 577 p.

Bigelow, H. B., L. Lillick, and M. Sears. 1940. Phytoplankton and planktonic protozoa of the offshore waters of the Gulf of Maine. Part I. Numerical distribution. Trans. Amer. Phil. Soc. 31:149-191.

Bigelow, H. B. and M. Sears. 1935. Studies of the waters on the continental shelf. Cape Cod to Chesapeake Bay. Part II. Salinity. Pap. Phys. Oceanog. 4(1): 94 p.

Bigelow, H. B. and M. Sears. 1939. Studies of the waters of the continental shelf, Cape Cod to Chesapeake Bay. III. A volumetric study of the Zooplankton. Mem. Mus. Comp. Zool. Harv. 54(4): 183-378.

Blaik, M., J. Northrop and C. S. Clay. 1959. Some seismic profiles onshore and offshore Long Island, New York. J. Geophys. Res. 64:231-239.

Blanton, W. G. and M. C. Robinson. 1973. Some acute effects of low-boiling petroleum fractions on the cellular structure of fish gills under field conditions, p. 265-273. In Ahearn and Meyers (ed.) The microbial degradation of oil pollutants. Louisiana State Univ. Pub. No. LSU-SG-73-01.

Blumer, M. 1969. Oil pollution of the sea, p. 5-13. In Hoult (ed.) Oil on the sea. Plenum Press, New York.

Blumer, M. 1971. Scientific aspects of the oil pollution problem. Environmental Affairs Vol. 1. p. 54-73.

Blumer, M., M. Ehrhardt and J. H. Jones. 1973. The environmental fate of stranded crude oil. Deepsea Research Vol. 20. Pergamon Press, London. p. 239-259.

Blumer, M., G. Souza and J. Sass. 1970. Hydrocarbon pollution of edible shellfish by an oil spill. Mar. Biol. 5:195-202.

Blumer, M. and J. Sass. 1972. Oil pollution: persistence and degradation of spilled fuel oil. Science Vol. 176. p. 1120-1122.

Blumer, M. and J. Sass. 1972. The West Falmouth oil spill, data available in November 1971, Part II, chemistry. Technical report of the Woods Hole Oceanographic Instit. No. 72-19. 60 p.

Blumer, M., P. C. Blokker, E. B. Cowell and D. F. Duckworth. 1972. Petroleum. In Goldberg (ed.) A Guide to Marine Pollution. Gordon and Breach, New York. p. 19-40.

Boesch, D. F. 1972. Species diversity of marine macrobenthos in the Virginia area. Ches. Sci. 13:206-211.

Boesch, D. F. 1973. Biological effects of chronic oil pollution on coastal ecosystems. In Background papers for a workshop on inputs, fates and effects of petroleum in the marine environment. Vol. 2. Prepared under the aegis of the Ocean Affairs Board, National Academy of Sciences. Washington, D. C.

Boesch, D. F., C. H. Hershner and J. H. Milgram. 1974. Oil spills and the marine environment. Ballinger Publishing Company, Cambridge. 114 p.

Bourn, R. Q., Jr. 1972. New submerged sites of coastal Connecticut. Archeol. Soc. of Conn. Bull. 37:4-16.

Bourne, W. R. 1968. Observation of an encounter between birds and floating oil. Nature 219(5154): 632.

Bousfield, E. L. 1965. Haustoriidae of New England (Crustacea: Amphipoda). Proc. U. S. Nat. Mus. 117:159-239.

Bousfield, E. L. 1973. Marine shallow water gammaridean Amphipoda of New England. Cornell Univ. Press. 312 p.

Bowditch, N. 1966. American Practical Navigator. U. S. Government Printing Office, Washington, D. C. 1524 p.

Bradley, Paul G. 1967. The economics of crude petroleum production. North-Holland Publishing Company, Amsterdam.

Braun, E. L. 1964. Deciduous forests of eastern North America. Hafner Publishing Company, New York. 596 p.

Briggs, W. and J. Shaug. 1973. Movement of oil on the surface of water by wind action. Report ME 156 CL. Dept. of Mech. Eng., Univ. of California. Santa Barbara, California.

Brimley, H. H. 1931. Harbor seal in North Carolina. J. Mammal. 12:314.

Broecker, W. S. 1974. Chemical Oceanography. Harcourt Brace Jovanovich, Inc., New York. 214 p.

Brower, W. A., D. D. Sisk and R. G. Quayle. 1972. Environmental guide for seven U. S. ports and harbor approaches. NOAA Environmental Data Service. National Climatic Center. Asheville, N. C. 166 p.

Brown, C. L. 1962. On the ecology of *Zastera marina* in Charlestown Pond, Rhode Island. M. S. Thesis, Univ. of Rhode Island. 52 p.

Brown, Keith C. 1969. Bidding for offshore oil; Southern Methodist University Press, Dallas, Texas.

Brown, Keith C. (ed.). 1972. Regulation of the natural gas producing industry, Washington, D. C.

Brown, M. V., J. Northrop, R. Frusetto and L. H. Grabner. 1961. Seismic refraction profiles on the continental shelf south of Bellport, Long Island, New York. Geological Soc. American Bull. 72:1693-1705.

Brown, P. M., J. A. Miller and F. M. Swain. 1972. Structural and stratigraphic framework and spatial distribution of permeability of the Atlantic coastal plain, North Carolina to New York. U. S. Geological Survey Prof. Pap. 796. U. S. Department of the Interior, Washington, D. C. 79 p., 59 pl.

Brownell, R. L. Jr., and B. J. LeBoeuf. 1971. California sea lion mortality: natural or artifact? p. 255-276 *In* Straughan (ed.) Biological and oceanographic survey of the Santa Barbara Channel oil spill, 1969-1970. Allan Hancock Foundation, Univ. of Southern California, Los Angeles.

Brownstein, Arthur M. 1972. U. S. Petrochemicals, technologies markets, economics. Petroleum Publishing Company, Tulsa.

Brunbach, J. J. 1965. The climate of Connecticut. State Geological and Natural Hist. Survey of Conn. Bull. 99. 215 p.

Bue, C. D. 1970. Stream flow from the United States into the Atlantic Ocean during 1931-1960. Contributions to the hydrology of the United States. Geological Survey Water Supply Pap. 1899-1. 36 p.

Bumpus, D. F. 1965. Residual drift along the bottom on the continental shelf in the Middle Atlantic Bight area. Limnol. and Oceanog. 10:R50-R53.

Bumpus, D. F. 1969. Reversals in the surface drift in the Middle Atlantic Bight area. Deep-Sea Res. Supp. to Vol. 16:17-23.

Bumpus, D. F. 1973a. A description of the circulation on the continental shelf of the east coast of the United States. *In* Progress in oceanography, Vol. 6. Pergamon Press, New York. 111-157.

Bumpus, D. F. 1973b. Physical oceanography (continental shelf, arms of the sea). *In* Coastal and offshore environmental inventory--Cape Hatteras to Nantucket Shoals. Marine Pub. Series No. 2. Univ. of Rhode Island. 1-1--1-46.

Bumpus, D. F. and L. M. Lauzier. 1965. Surface circulation on the continental shelf off eastern North America between Newfoundland and Florida. Am. Geograph. Soc. Serial Atlas of the Marine Environment Folio 7. 4 p.

Burns, K. A. and T. M. Teal. 1971. Hydrocarbon incorporation into the salt marsh ecosystem from the West Falmouth oil spill. Technical report of the Woods Hole Oceanographic Institute No. 71-69. 24 p.

Butler, James N. 1975. Evaporative weathering of petroleum residues: the age of pelagic tar. In Press, Marine Chemistry.

Butler, J. N., B. F. Morris and J. Sass. 1973. Pelagic tar from Bermuda and the Sargasso Sea. Bermuda Biological Station for Research. Spec. Pub. No. 10. Harvard University Printing Office. Cambridge, Mass. 346 p.

Bybee, H. H. 1971. Multiple use of the Gulf of Mexico. Continental Oil Company, Houston, Texas. p. 68

Cabinet Task Force on Oil Import Control. 1970. The oil import question: a report on the relationship of oil imports to national security. U. S. Government Printing Office, Washington, D. C.

Caldwell, D. K. and F. B. Golley. 1965. Marine mammals from the coast of Georgia to Cape Hatteras. J. Elisha Mitchell Sci. Soc. 81: 24-32.

California Department of Fish and Game. 1969. Santa Barbara oil leak. Interim report, December 15. 48 p.

Calvert County (Maryland) Planning Office. Land use data for Calvert County (compilation of information (1973 data) assembled from other sources). Prince Frederick, Maryland.

Cape May County Planning Board. 1973. Population projections for Cape May county, 1970-2010. Cape May Court House, New Jersey. 27 p.

Cape May County (New Jersey) Planning Board. 1970. Population characteristics of Cape May county, New Jersey. Cape May Court House, New Jersey. 38 p.

Cape May County (New Jersey) Planning Board Data Book, Cape May County, New Jersey. Cape May Court House, New Jersey. No date. Unnumbered pages.

Carlson, R. O. and M. V. Brown. 1955. Seismic refraction profiles in the submerged Atlantic coastal plain near Ambrose Lightship. Geol. Soc. America Bull. 66:969-976.

Carriker, M. R. 1955. Seasonal vertical movements of oyster drills (*Urosalpinx cinerea*). Proc. Nat. Shellfish Ass. 45: 190-198.

Carriker, M. R. 1967. Ecology of estuarine benthic invertebrates: a perspective. *In* Lauff (ed.) Estuaries AAAS., Pub. 83:442-487.

Chan, G. 1972. A study of the effects of the San Francisco oil spill on marine organisms. Part I. College of Marin, Kentfield, California. 78 p.

Chao, Y-Y. 1974. Wave refraction phenomena over the continental shelf near the Chesapeake Bay entrance. T.M. 47. U. S. Army, Corps of Engineers. Coastal Engineering Research Center. Fort Belvoir, Virginia. 53 p.

Chao, Y-Y. 1975. Recent progress in wave refraction studies and its application in the Mid-Atlantic Bight. Paper prepared for the university seminars on pollution and water resources, Columbia University. New York 34 p.

Charter, D. B., R. A. Sutherland and J. D. Porricelli. 1973. Quantitative estimates of petroleum to the oceans. Nat. Academy of Sci., Natural Res. Council.

Chase, J. 1959. Wind-induced changes in the water column along the east coast of the United States. J.G.R. 64(B): 1013-1022.

Chenoweth, S. 1973. Fish larvae of the estuaries and coast of central Maine. Fish. Bull. U. S. 71: 105-113.

Chrysler, M. A. 1930. The origin and development of the vegetation of Sandy Hook. Bull. Torr. Bot. Club. 57: 163-176.

Chubb, J. C. 1954. Observations on oiled birds, 1951-1953. Northwest Natur. 2:460-461.

Clark, G. A., H. Meisler, E. C. Rhodehamel and H. E. Gill. 1968. Summary of ground water resources of Atlantic county, New Jersey. Water Resources Circular No. 18. New Jersey Department of Conservation and Economic Development, Trenton, New Jersey. 53 p., 1 pl.

Clark. J. 1967. Fish and man. Conflict in the Atlantic estuaries. Am. Littoral Soc. Special Pub. No. 5. 78 p.

Clark, J. 1968. Seasonal movements of striped bass contingents of Long Island Sound and the New York Bight. Trans. Amer. Fish. Soc. 97 (4): 320-343.

Clark, R. B. 1969. Oil pollution and the conservation of sea birds. Proc. Intl. Conf. Oil Pollution of the Sea, Rome. p. 76-112.

Clark, R. B. 1971. Oil pollution and its biological consequences. A review of current scientific literature. Prepared for Great Barrier Reef Petroleum Drilling Royal Commissions. 111 p.

Clark, R. B. 1973. Biological fates of petroleum hydrocarbons in aquatic micro-organisms. *In* Background papers for a workshop on inputs, fates, and effects of petroleum in the marine environment. Vol. 2. Prepared under the aegis of the Ocean Affairs Board, National Academy of Sciences, Washington, D. C.

Clarke, G. L. 1940. Comparative richness of zooplankton in coastal and offshore areas of the Atlantic. Biol. Bull. 78(2): 226-255.

Cobb, J. S. 1968. Delay of molt by the larvae of *Homarus americanus*. J. Fish Res. Bd. Can. 25:2251-2253.

Cobb, J. S. 1969. Activity, growth and shelter selection of the American lobster. Ph.D. Thesis, Univ. of Rhode Island.

Cohen, P. and G. E. Kimmel. 1970. Status of salt water encroachment in 1969 in southern Nassau and southeastern Queens counties, Long Island, New York. *In* U. S. Geological Survey Prof. Pap. 700-D. U. S. Department of the Interior, Washington, D. C. p. 281-286.

Colton, J. B. Jr. 1955. Spring and summer distribution of haddock on Georges Bank. U. S. Fish and Wildlife Service Spec. Sci. Report. Fish. 156. 56 p.

Colton, J. B. Jr. and R. R. Stoddard. 1972. Average monthly sea-water temperatures, Nova Scotia to Long Island, 1940-1959. Am. Geog. Soc. Serial Atlas of the Marine Environment Folio. 21. 2 p. 10 pl., APP.

Colton, J. B. Jr. and R. F. Temple. 1961. The enigma of Georges Bank spawning. Limnol. Oceanog. 6(3): 280-291.

Colton, J. B. Jr., R. R. Marak, S. R. Nickerson and R. R. Stoddard. 1968. Physical, chemical and biological observations on the continental shelf, Nova Scotia to Long Island, 1964-1966. U. S. Fish and Wildlife Service Data Report 23. 190 p.

Conard, H. S. 1935. The plant associations of central Long Island. Amer. Midland Natur. 16: 433-516.

Connel, D. W. 1971. Kerosene-like tainting in Australian mullet. Australian Wine Research Institute, S. Australia. Glen Osmond.

Connell, J. H. 1961. The influence of interspecific competition and other factors on the distribution of the barnacle. *Chthamalus stellatus*. Ecol. 42: 710-723.

Connell, J. H. 1970. A predator prey system in the marine intertidal region. 1. *Balanus glandula* and several predatory species of *Thais*. Ecol. Monogr. 40:49-78.

Connell, J. H. 1973. A review of: D. Straughan. 1971. Biological and oceanographical survey of the Santa Barbara Channel oil spill. Allan Hancock Foundation, Univ. of Southern California, Los Angeles. 426 p. A guide to the proper method of investigation of the effects of oil pollution on marine organisms. Submission to the California State Lands Commission.

Conover, R. J. 1956. Oceanography of Long Island Sound 1952-54. VI. Biology of *Acortia clausi* and *Acortia tonsa*. Bingham Oceanog. Coll. Bull. 15:156-233.

Conover, R. J. 1961. A study of Charlestown and Green Hill Ponds, Rhode Island. 42(1): 119-140.

Cooke, C. W. 1935. Tentative ages of Pleistocene shorelines. J. of Washington Academy of Sciences. 25: 331-333.

Cooper, R. A. 1970. Retention of marks and their effects on growth, behavior and migrations of the American lobster, *Homarus americanus*. Trans. Amer. Fish. Soc. 99:409-417.

Cooper, R. A. and J. R. Uzmann. 1971. Migration and growth of deep-sea lobsters, *Homarus americanus*. Sci. 171: 288-290.

Corwin, N. 1970. Reduced data reports for Gosnold Cruise 140, and Atlantis II Cruise 52. Appendix I. Woods Hole Oceanographic Institute. Ref. No. 70-15. ·41 p.

Costin, M., P. Davis, R. Gerard and B. Katz. 1963. Dye diffusion experiments in New York Bight. Columbia University. Lamont Geol. Obs. Tech. Report CU-2-63.

Council of Economic Advisors. 1974, 1975. Economic report of the President. U. S. Government Printing Office. Washington, D. C.

Council on Environmental Quality. 1973. The fourth annual report of the Council on Environmental Quality. Washington, D. C. 499 p.

Council on Environmental Quality. 1974. OCS oil and gas--an environmental assessment Vol. 1-5. U. S. Government Printing Office. Washington, D. C.

Council on Environmental Quality. 1974. The fifth annual report of the Council on Environmental Quality. Washington, D. C. 597 p.

Cowell, E. B. 1969. The effects of oil pollution on salt marsh communities in Penbrokeshire and Cornwall. J. Applied Ecol. 6:133-142.

Crater Planning District Commission. 1973. The Land Development Plan 1990. Petersburg, Virginia. 109 p.

Cresswell, G. M. 1967. Quasi-synoptic monthly hydrography of the transition region between coastal and slope water south of Cape Cod, Mass. WHOI Tech. Report No. 67-35. 114 p.

Critical Environmental Areas. December 1972. Division of State Planning and Community Affairs. Richmond, Virginia.

Croker, R. A. 1965. Planktonic fish eggs and larvae of Sandy Hook estuary. Chesapeake Sci. 6(2): 92-95.

Croker, R. A. 1967. Niche diversity in five sympatric species of intertidal amphipods (Crustacea: Haustoriidae). Ecol. Monogr. 37: 173-200.

Croker, R. A. 1970. Intertidal sand macrofauna from Long Island, New York, Ches. Sci. 11: 134-137.

Cronan, J. M. and A. Brooks. 1962. The mammals of Rhode Island. R. I. Dept. of Agriculture and Conservation, Division of Fish and Game Pam. No. 6. 133 p.

Cronin, L. E., J. C. Daiber and E. M. Hulburt. 1962. Quantitative seasonal aspects of zooplankton in the Delaware River estuary. Ches. Sci. 3: 63-93.

Cross, D. 1970. New Jersey's Indians. New Jersey State Museum Report #1. Trenton, New Jersey. 95 p.

Cross, D., H. B. Kummel, H. G. Richards and N. Knowles. 1941. Archaeology of New Jersey. Vol. I. Archaeological Soc. of New Jersey and the New Jersey State Museum, Trenton, New Jersey. 271 p., 75 pl.

Crutcher, H. L. and R. G. Quayle. 1974. Mariners worldwide climatic guide to tropical storms at sea. U. S. Department of Commerce. NOAA/EDS National Climatic Center. 114 p., 312 charts.

Cry, G. W. 1965. Tropical cyclones of the North Atlantic Ocean. U. S. Weather Bur. Tech. Pap. 55. 148 p.

Cry, G. W. and W. H. Haggard. 1962. North Atlantic tropical cyclone activity, 1901-1960. Mon. Weather Rev. 90 (8): 341-349.

Cumberland County (New Jersey) Planning Board. 1966. The Cumberland Plan. Bridgeton, New Jersey. 196 p.

Darmstadter, Joel. 1972. Energy in the world economy. Johns Hopkins Press, Baltimore.

Dashu, N. 1947. Thecal morphology of some dinoflagellates of Woods Hole, with special reference to the "ventral area." Biol. Bull. 93(2): 210.

Day, J. H. 1973. New polychaeta from Beaufort with a key to all species recorded from North Carolina. NOAA Tech. Report. NMFS CIRC-375. 140 p.

Dayton, P. K. 1971. Competition, disturbance and community organization: The provision and subsequent utilization of space in a rocky intertidal community. Ecol. Monogr. 41:351-389.

Dean, D. and H. Haskin. 1964. Benthic repopulation of the Raritan River estuary following pollution abatement. Limnol. Oceanogr. 9:551-563.

Deevey, G. B. 1948. The zooplankton of Tisbury Great Pond. Bull. Bing. Oceanogr. Coll. 12(1): 44.

Deevey, G. B. 1952a. A survey of the zooplankton of Block Island Sound, 1943-1946. Bull. Bingh. Oceangr. Coll. 13(3): 65-119.

Deevey, G. B. 1952b. Quantity and composition of the zooplankton of Block Island Sound, 1949. Bull. Bingh. Oceanogr. Coll. 13(3): 120-164.

Delaware. 1974. State plan for solid waste management State of Delaware. Prepared for Department of Natural Resources and Environmental Control. 19 p.

Delaware Comprehensive Outdoor Recreation Plan. 1970. State Planning Office, State of Delaware. Dover, Delaware.

Delaware Valley Regional Planning Commission. 1970 land use file computer printouts, Philadelphia, Pennsylvania. (Printouts obtained directly from Commission by request.)

Dennis, J. V. 1959. Oil pollution survey of the United States Atlantic coast. American Petroleum Institute. Washington, D. C. 75 p.

Department of Health and Mental Hygiene. 1973. Maryland State yearly air quality data report. 134 p.

Devanney, John W. III. 1973. Key issues in offshore oil: World energy and the oceans. Second annual sea grant lecture. MIT, Cambridge.

Devanney, John W. III and R. J. Stewart. 1974. Long Island spill trajectory study. Report to Regional Marine Resources Council Nassau-Suffolk Planning Board. 35 p.

Devanney, John W. III and R. J. Stewart. 1974. Analysis of oil spill statistics. In Primary, physical impacts of offshore petroleum developments. Report No. MITSG 74-20. MIT, Cambridge. 126 p.

Dexter, D. M. 1967. Distribution and niche diversity of haustoriid amphipods in North Carolina. Ches. Sci. 8:187-192.

Dexter, D. M. 1969. Structure of an intertidal sandy beach community in North Carolina. Ches. Sci. 10:93-98.

Diaz-Piferrer, M. 1962. The effects of an oil spill on the shore of Guanica, Puerto Rico. Association of Island Marine Laboratories, Fourth meeting, Caracao. p. 12-13.

Dodd, E. N. 1971. The effects of natural factors on the movement, dispersal, and destruction of oil at sea. U. K. Ministry of Defense (Navy Department). Also available as NTIS, AD763042. Springfield, Massachusetts.

Dolan, R., P. J. Godfrey and W. E. Odum. 1973. Man's impact on the barrier islands of North Carolina. Amer. Sci. 61: 152-162.

Doudoroff, P. 1938. Reaction of marine fishes to temperature gradients. Biol. Bull. Woods Hole 75: 494-509.

Dow, R. L., P. L. Goggins and J. Hughes. 1966. The American lobster. Marine Resources of the Atlantic coast, Leaflet 5. Atl. States Mar. Fish. Comm.

Drake, C. L., M. Ewing and G. H. Sutton. 1959. Continental margins and geosynclines--the east coast of North America north of Cape Hatteras. In Aherns, et al (eds.) Physics and chemistry of the earth. Pergamon Press, New York. 3:110-199.

Drake, C. L., J. R. Heirtzler and J. Hirschman. 1963. Magnetic anomalies off eastern North America. J. Geophysical Res. 68: 5259-5275.

Drake, C. L., J. L. Worzel, W. C. Beckmann. 1954. Geophysical investigations in the emerged and submerged Atlantic coastal plain, Part 9: Gulf of Maine. Geol. Soc. America Bull. 65: 957-970.

Duane, D. B. 1969. A study of New Jersey and northern New England coastal waters. Shore and Beach 37(2): 12-16.

Duane, D. B., M. E. Field, E. P. Meisburger, D. J. P. Swift and S. J. Williams. 1972. Linear shoals on the Atlantic inner continental shelf, Florida to Long Island. In Swift, Duane and Pilkey (eds.) Shelf sediment transport. Dowden, Hutchinson and Ross, Inc. Stroudsburg, Pennsylvania. p. 447-498.

Durand, J. B., and R. J. Nadeau. 1972. Water resources development in the Mullica River Basin. Part 1. Biological evaluation of the Mullica River-Great Bay estuary. New Jersey Water Resources Research Institute, Rutgers University.

Eardly, A. J. 1962. Structural geology of North America (2nd ed.). Harper and Row, New York. 743 p.

Ebeling, A. W., F. A. DeWitt, W. Werner and G. M. Cailliet. 1970. Santa Barbara oil spill: Fishes. In Holmes and DeWitt (eds.) Santa Barbara oil symposium, Santa Barbara, December 16-18. University of California.

Economic impact of the New Jersey travel and resort industry. 1974. Stockton State College. Pomona, New Jersey.

EG&G, Environmental Consultants. 1974. Summary of oceanographic observations in New Jersey coastal waters near 39^0 28'N latitude and 74^0 15'W longitude during the period May 1972 through April 1973. Waltham, Mass.

Ehrhardt, M. 1972. Petroleum hydrocarbons in oysters from Galveston Bay. Environ. Poll. 3:257-272.

Einarsson, H. 1945. Euphausiacea. I. North Atlantic species. Dana Rep. No. 27. Copenhagen. p. 1-185.

Ells, J. W. 1975. Scours and spanning threaten sea lines. Oil and Gas J. 73(27): 67-71.

Emery, K. O. 1969. A coastal pond studied by oceanographic methods. Amer. Elsevier Publ. Co., Inc., New York. 80 p.

Emery, K. O. and Edwards, R. L. 1966. Archaeological potential of the Atlantic continental shelf. American Antiquity 31:733-737.

Emery, K. O., J. O. Phillips, C. O. Bowin, E. T. Bunce and S. T. Knott. 1970. Continental rise off eastern North America. Am. Assoc. Petrol. Geol. Bull. 54 (1): 44-108.

Emery, K. O. and E. Uchupi. 1972. Western North Atlantic Ocean: Topography, rocks, structure, water, life and sediments. Amer. Assoc. Petrol. Geol. Memoir 17. 532 p.

Environmental Technical Applications Center. 1967. Climatic Data Summary, Mitchel AFB, New York. Washington, D. C. 2 p.

Environmental Technical Applications Center. 1969. AWS climatic brief, McGuire AFB/ Wrightstown, N. J. Washington, D. C. 1 p.

Environmental Technical Applications Center. 1970. AWS climatic brief, Suffolk Co. AFB/Westhampton Beach, N. Y. Washington, D. C. 1 p.

Environmental Technical Applications Center. 1974. AWS climatic brief, Dover AFB, Delaware. Washington, D. C. 1 p.

Environmental Protection Agency. 1971. Rules and Regulations. National primary and secondary ambient air quality standards. Federal Register. Vol. 36. No. 84.

Environmental Protection Agency. 1973. Ocean Dumping in the New York Bight: facts and figures. Region II, Surveillance and Analysis Division.

Environmental Protection Agency. 1974a. Rules and Regulations. Approval and promulgation of implementation plans. Prevention of significant air quality deterioration. Federal Register. Vol. 39. No. 235.

Environmental Protection Agency. 1974b. Brine disposal treatment practices relating to the oil production industry. Washington, D. C. U. S. Environmental Protection Agency. EP-660/2-74-037. p. 1.

Environmental Protection Agency. 1974c. Ocean disposal activities: 1973-1974. FY 1974 Annual Report of Region II, Surveillance and Analysis Division.

Environmental Protection Agency. 1974d. Ocean dumping in the New York Bight: facts and figures. EPA, Region II.

Environmental Protection Agency. 1974e. Ocean disposal in the New York Bight. Tech. Briefing Report No. 1. Region II, Surveillance and Analysis Division.

Environmental Protection Agency. 1975a. Ocean disposal in the New York Bight. Tech. Briefing Report No. 2. USEPA. Region II, Surveillance and Analysis Division. 86 p.

Environmental Protection Agency. 1975b. Ocean dumping in the United States--1975. Third Annual Report of the Environmental Protection Agency. 58 p.

Environmental Protection Agency and International Research and Technology Corporation. 1975. Environmental consequences of onshore activity in four New Jersey coastal counties resulting from offshore oil developmnent. 42 p. Unpublished.

Erickson, R. C. 1963. Oil pollution and migratory birds. Atl. Nat. 18(1): 5-15.

Ewing, M. 1940. Geophysical investigations in the emerged and submerged Atlantic coastal plain, Part 4: Cape May, N. J. sections. Geol. Soc. America Bull. 51: 1821-1840.

Ewing, M., A. P. Crary and H. M. Rutherford. 1937. Geophysical investigations in the emerged and submerged Atlantic coastal plain, Part 1: methods and results. Geol. Soc. America Bull. 48: 753-802.

Ewing, M., G. P. Woolard and A. C. Vine. 1939. Geophysical investigations in the emerged and submerged Atlantic coastal plain, Part 3: Barnegat Bay, N. J. section. Geol. Soc. America Bull. 50: 257-296.

Ewing, M., J. L. Worzel, N. C. Steenland and F. Press. 1950. Geophysical investigations in the emerged and submerged Atlantic coastal plain, Part 5: Woods Hole, New York and Cape May sections. Geol. Soc. America Bull. 61: 877-892.

Exxon Production Research Company. 1974. Operational seastates and wind conditions for the U. S. Atlantic coast. Houston, Texas. Unpublished.

Fauchald, K. 1971. The benthic fauna in the Santa Barbara Channel following the January 1969 oil spill. In D. Straughan (ed.) Biological and oceanographic survey of the Santa Barbara Channel oil spill, 1969-1970. Allan Hancock Foundation, Univ. of Southern California, Los Angeles.

Fay, J. A. 1969. The spread of oil slicks on a calm sea. In D. P. Hoult (ed.) Plenum Press, New York. 53-63.

Feldman, M. H. 1973. Petroleum Weathering: some pathways, face and disposition on marine waters. EPA 660/3-73-013. U. S. National Environmental Research Center, USEPA. Corvallis, Oregon. 19 p.

Ferrara, R. N. 1953. Phytoplankton studies in upper Narragansett Bay. M. S. Thesis, Univ. Rhode Island

Field, M. E. 1975. Evolution of Quarternary sedimentary record of inner continental shelf of Delaware, Maryland and northernmost Virginia. George Washington Univ., Washington, D.C., Unpub. Ph. D. dissertation.

Fire Island national seashore: master plan and environmental impact statement (draft) 1975. North Atlantic Region, National Park Service, U. S. Department of the Interior. Boston, Massachusettts.

Fish, C. J. 1925. Seasonal distribution of the plankton in the Woods Hole region. Bull., U. S. Bureau of Fish. 41: 91-179.

Fish, C. J. and M. W. Johnson. 1937. The biology of the zooplankton population in the Bay of Fundy and Gulf of Maine with special reference to production and distribution. J. Biol. Bd. Can. 3(3): 189-322.

Fisher, A. A. Jr. 1973. Environmental guide to the Virginia capes operating area. Spec. Pub. 211. U. S. Naval Oceanographic Office. Washington, D. C. 58 p.

Fiske, J. D., C. E. Watson and P. G. Coates. 1966. A study of the marine resources of the North River. Mass. Div. Mar. Fish. Monogr. No. 3.

Fleischer, P. and R. L. Fleischer. 1971. Cretaceous and tertiary rocks from the Carolina continental slope (abstract). Geol. Soc. America, Abs. with Programs. 3 (7): 566.

Ford Foundation Energy Policy Project. 1974. Exploring energy choices. The Ford Foundation. Washington, D. C.

Ford Foundation. 1974. A time to choose. Ballinger Publishing Co. Cambridge, Mass.

Ford, W. L. and A. R. Miller. 1952. The surface layers of the Gulf Stream and adjacent waters. J. Mar. Res. 11: 267-280.

Ford, W. L., J. R. Longard and R. E. Banks. 1952. On the nature, occurrence and origin of cold low salinity water along the edge of the Gulf Stream. J. Mar. Res. 11:281-293.

Forecast of Outdoor Recreation in New York State, 1970-1990. 1973. New York Statewide comprehensive recreation plan. Office of Parks and Recreation, New York State Department of Environmental Conservation. Albany, New York.

Foster, M., M. Neushal and R. Zingmark. 1971. The Santa Barbara oil spill. Part II: Initial effects of intertidal and kelp bed organisms. Environ. Poll. 2: 115-136.

Frank, O. L. and N. G. McClymonds. 1972. Summary of the hydrologic situation on Long Island, New York, as a guide to water management alternatives. U. S. Geological Survey Prof. Pap. 627-F. U. S. Department of the Interior, Washington, D. C. 59 p.

Frank, W. M. and G. M. Friedman. 1973. Continental shelf sediments off New Jersey. J. Sed. Petrol. 43:224-237.

Fraser, J. H. 1970. The ecology of the ctenophore Pleurobrachia pileus in Scottish waters. ICES J. du Conseil., Vol. 33, No. 2.

Freegarde, M. and C. G. Hatchett. 1970. The ultimate fate of crude oil at sea. Admirality Materials Laboratory Interim Report No 7.

Freudenthal, H. D. and J. J. Lee. 1963. Glenodinium halli N. Sp. and Gyrodinium instriatum N. Sp., dinoflagellates from New York waters. J. Protozool. 10(2):182-189.

Frolander, H. T. 1955. The biology of the zooplankton of Narragansett Bay area. Ph.D. Thesis, Brown Univ., R. I. 94 p.

Galli, J. 1975. Personal Communication. State of New Jersey, Department of Environmental Protection.

Galtsoff, P. S. 1964. The American oyster Crassostrea virginica. U. S. Fish and Wildlife Service. Fish. Bull. 64: 480 p.

Galtsoff, P. S., H. F. Prytherch, R. O. Smith and V. Koehring. 1935. Effects of crude oil pollution on oysters in Louisiana waters. Bull. Bur. Fish. 18: 143-210.

Garrett, W. D. 1969. Confinement and control of oil pollution on water with monomolecular surface films. In Proceedings of joint conference on prevention and control of oil spills. Sponsored by API and FWPCA. p. 257-261.

Garrett, W. D. 1972. Impact of petroleum spills on the chemical and physical properties of the air/sea interface. NRL Report 7372. Naval Research Laboratory. Washington, D. C. 15 p.

Gary, M., R. McAfee Jr., and C. L. Wolfe (eds.). 1972. Glossary of geology. Am. Geol. Inst. Washington, D. C. 805 p. 52A.

Gates, J. M. and G. C. Matthiessen. 19[illegible]. An economic perspective. In T. A. Gaucher (ed.) Aquaculture: a New England perspective. p. 22-50.

Gibson, R. N. 1969. The biology and behavior of littoral fish. Oceanogr. Mar. Biol. Ann. Rev. 7: 367-410.

Gibson, T. G. 1965. Eocene and miocene rocks off the northeastern coast of the United States. Deep-Sea Res. 12: 975-981.

Gill, H. E. 1962. Ground water resources of Cape May, County, New Jersey. Salt water invasion of principal aquifers. Spec. Report 18. New Jersey, Department of Conservation and Economic Development. 171 p., 4 pl.

Glaser, J. D. 1968. Coastal plain geology of southern Maryland. Maryland Geological Survey Guidebook #1. 56 p.

Glaser, J. D. 1969. Petrology and origin of Potomac and Magothy (Cretaceous) sediments, middle Atlantic coastal plain. Maryland Geological Survey Report Inv. #11. 102 p.

Glebe, B. D. 1974. The energetic cost of the spawning migration of the American shad (Alosa sapidissima, Wilson). Abstracts of papers. 1974 N. E. Fish and Wildlife Conf.

Goldberg, E. D. (ed.). 1972. Baseline studies of heavy metal, halogenated hydrocarbon and petroleum hydrocarbon pollutants in the marine environment and research recommendations. NTIS PB 233 959.

Goldsmith, V., W. D. Morris, R. J. Byrne and C. H. Whitlock. 1974. Wave climate model of the mid-Atlantic shelf and shoreline (Virginian Sea). NASA Sp-358. Scientific and Technical Information Office. NASA. Washington, D. C. 146 p.

Gooding R. M. 1971. Oil pollution on Wake Island from the tanker R. C. Stoner. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Spec. Report--Fisheries No. 636. 12 p.

Goodman, Joel M. 1975. Decisions for Delaware: Sea Grant looks at OCS development. College of Marine Studies, Univ. of Delaware. Newark, Delaware.

Goodwin, B. K. 1964. Guidebook to the geology of the Philadelphia area. Pennsylvania Geological Survey Bull. G 41. Pennsylvania Department of Internal Affairs, Harrisburg, Pennsylvania. 189 p.

Goodwin, G. 1935. Mammals of Connecticut. State geological and natural history survey of Connecticut Bull. No. 53. 221 p.

Gordon, A. L. and R. D. Girard. 1973. Wind drift surface currents and spread of contaminants in shelf waters. Report No. CG-D-5-75. U. S. Coast Guard, Washington, D. C. 58 p.

Gordon, D. C. Jr., and N. J. Prouse. 1973. The effects of three oils on marine phytoplankton photosynthesis. Mar. Biol. 22: 329-333.

Governor's Task Force on Marine and Coastal Affairs. 1972. The coastal zone of Delaware, a plan for action in Delaware. College of Marine Studies, Univ. of Delaware. Newark, Delaware. 464 p.

Graham, J. J., S. Chenoweth and C. Davis. 1972. Abundance, distribution, movements and lengths of larval herring along the western coast of the Gulf of Maine. Fish. Bull. 70: 307-321.

Gray, I. E., M. E. Downey and M. J. Cerame-Vivas. 1908. Seastars of North Carolina. Fish. Bull. 67: 127-163.

Greenhorne and O'Mara, Inc. (Riverdale, Maryland). 1974. For Charles County (Maryland) Planning Commission. Proposed Comprehensive Plan. La Plata, Maryland.

Grice, G. D. and A. D. Hart. 1962. The abundance, seasonal occurrence and distribution of the epizooplankton between New York and Bermuda. Ecol. Monogr. 32: 287-307.

Griffith, R. E. 1961. Phytoplankton of Chesapeake Bay. An illustrated guide to the genera. Hood College Monogr. No. 1, Frederick, Md., and Cont. No. 172, Ches. Biol. Lab., Maryland Department Res. and Ed., Solomons, Maryland. 79 p.

Grigalunas, Thomas A. 1972. Regional impacts of potential offshore petroleum development. Marine Technology Society, Eighth Annual Conference. Proceedings. p. 491-497.

Grigalunas, Thomas A. 1974. The economic impact of potential development on the Atlantic outer continental shelf. Testimony before the National Ocean Policy Committee, United States Senate. Washington, D. C.

Grigalunas, Thomas A. 1975. Offshore petroleum and New England. University of Rhode Island, Kingston.

Griscom, C. A. and W. T. Sommers. 1969. Tidal currents and coastal drift in the vicinity of the head of Hudson Canyon. AIAA Pap. No. 69-411. 12 p.

Gross, M. G. 1970. Analysis of dredged wastes,fly-ash and waste chemicals. New York Metropolitan Region Tech. Report No. 7. Mar. Sci. Res. Center, State Univ. of New York. Stony Brook, New York. NTIS AD 74 6 959.

Gross, M. G. 1972. Geologic aspects of waste solids and marine waste deposits. New York Metropolitan Region, Geol. Soc. of Amer. Bull. 83. p. 3163-3176.

Groutage, T. M. and A. M. Barker. 1967. The Atlantic surf clam fishery in 1966. Comm. Fish. Rev. 29: (8-9): 64-67.

Gulland, J. A. 1965. The survival of the youngest stages of fish and its relation to year-class strength. ICNAF Spec. Publ. 6: 363-372.

Gunter, G. 1961. Some relations of estuarine organisms to salinity. Limnol. and Oceanogr. 6: 182-190.

Haight, F. J. 1942. Coastal currents along the Atlantic coast of the United States. U. S. Coast and Geodetic Survey. Spec. Pub. No. 230. 73 p.

Hall, C. A. 1964. Shallow water marine climates and molluscan provinces. Ecol. 45: 226-234.

Hall, E. R. and K. R. Kelson. 1959. The mammals of North America. Ronald Press Co., New York. 2: 547-1083.

Hallam, A. 1971. Mesozoic geology and the opening of the North Atlantic. J. Geol. 79(2): 129-157.

Halvorson. W. L. and C. G. Dawson. 1973. Coastal vegetation, p. 9-1 to 9-92. In S. Saila (ed.) Coastal and offshore environmental inventory Cape Hatteras to Nantucket Shoals. Univ. of Rhode Island, Kingston.

Handley, C. O. 1966. A synopsis of the genus Kogia (Pigmy sperm whales). In K. S. Norris (ed.) Whales, dolphins, and porpoises. Univ. of California Press, Berkeley and Los Angeles. 16: 789 p.

Hanks, R. W. 1968. Benthic community formation in a "new" marine environment. Ches. Sci. 9: 163-172.

Harger, J. R. 1972. Competitive coexistence among intertidal invertebrates. Amer. Sci. 60: 600-607.

Harland Barthomew and Assoc. 1968. For Caroline County Planning Commission. Denton, Maryland. 113 p.

Harris, Curtis C. Jr. 1973. The urban economies, 1985: a multiregional multi-industry forecasting model. D. C. Heath and Co. Lexington, Mass.

Harris, Curtis C., Jr. and Frank E. Hopkins. 1974. Locational analysis. D. C. Heath and Co. Lexington, Mass.

Harris, D. L. 1963. Characteristics of the hurricane storm surge. U. S. Weather Bureau Tech. Pap. No. 48. Washington, D. C. 139 p.

Harris, E. 1959. The nitrogen cycle in Long Island Sound. Bull. Bingham Oceanogr. Coll. 17(1): 31-65.

Harrison, W., J. J. Norcross, N. A. Pore and E. M. Stanley. 1967. Circulation of shelf waters off the Chesapeake Bight. surface and bottom drift of continental shelf waters between Cape Henlopen, Delaware and Cape Hatteras, N. C., June 1963-December 1964. ESSA Prof. Pap. 3. U. S. Department of Commerce. 82 p.

Harshberger, J. W. 1900. An ecological study of the New Jersey strand flora. Acad. Natur. Sci. Phila. Proc. 1900: 623-671.

Hartung. R. 1965. Some effects of oiling on reproduction of ducks. J. Wildl. Mgmt. 29(4): 872-874.

Hartung, R. 1967. Energy metabolism in oil-covered ducks. J. Wildl. Mgmt. 31(4): 798-804.

Hartung, R. and G. S. Hunt. 1966. Toxicity of some oils to waterfowl. J. Wildl. Mgmt. 30(3): 564-570.

Harvey. H. W. 1950. On the production of living matter in the sea off Plymouth. J. Mar. Biol. Ass. U. K. 29: 97-137.

Haskin, H. H., W. J. Canjonier and J. L. Myhre. 1965. The history of MSX on Delaware Bay oyster grounds. 1957-1965 Amer. Malacol. Union Bull. 32: 20-21.

Haskin, H. H., T. A. Stauber and J. G. Mackin. 1966. Minchinia nelsoni: causative agent of the Delaware Bay oyster epizootic. Sci. 153(3742): 1414-1416.

Hasler, H. D. 1970. In Sondheimer and Simeone (eds.). Chemical ecology. Academic Press.

Havens, J. M., D. M. Shaw and E. R. Levine. 1973. Offshore weather and climate. In Coastal and offshore environmental inventory--Cape Hatteras to Nantucket Shoals. Marine Pub. Series No. 3. Univ. of Rhode Island. 11-1--11-43.

Hawkes, A. L. 1961. A review of the nature and extent of damage caused by oil pollution at sea. Transactions of the North American Wildlife Conference. 26: 343-355.

Hedgpeth. J. W. 1957. Estuaries and lagoons. II. Biological Aspects. Geol. Soc. Amer. Mem. 67(1): 693-729.

Heezen, B. C., M. Tharp and M. Ewing. 1959. The floors of the oceans, 1. The North Atlantic Geol. Soc. of Amer. Spec. Pap. 65. 122 p.

Hempel, G. 1963. On the importance of larval survival for population dynamics of marine food fish. Calif. Coop. Ocean. Fish. Invest. Repts. 10: 1-23.

Hendricks, T. A. 1965. Resources of oil, gas, and natural gas liquids in the United States and the world. U. S. Geological Survey Circ. 522. U. S. Department of the Interior, Washington, D. C. 20 p.

Henry, K. A. 1971. Atlantic menhaden (Brevoortia tyrannus): resources and fishery-analysis of decline. NOAA Tech. Rept. NMFS, SSRF-642: 1-32.

Heppner, F. H. and L. L. Gould. 1973. Birds of the Atlantic seaboard from Cape Hatteras to Cape Cod. In S. Saila (ed.) Coastal and offshore environmental inventory, Cape Hatteras to Nantucket Shoals. Univ. of Rhode Island, Kingston.

Herman, S. J. 1963. Planktonic fish eggs and larvae of Narragansett Bay. Limnol. and Oceanogr. 8(1): 103-109.

Herman, S. J. and J. A. Mihursky. 1964. Infestation of the capepod *Acartia tonsa* with stalked ciliate zoothamnium. Sci. 146(3643): 543-576.

Herman, S. S., J. A. Mihursky and A. M. McErlean. 1968. Zooplankton and environmental characteristics of the Patuxent River estuary 1963-1965. Ches. Sci. 9(2): 67-82.

Herrick, F. H. 1911. Natural history of the American lobster. Bull. U. S. Bur. Fish. (1909) 29: 149-408.

Hersey, J. B., E. T. Bunce, R. F. Wyrick and F. T. Dietz. 1959. Geophysical investigation of the continental margin between Cape Henry, Virginia and Jacksonville, Florida. Geological Soc. America Bull. 70: 437-466.

Hicks, S. D., A. J. Goodheart and C. W. Iseley. 1965. Observations of the tide on the Atlantic continental shelf. J.G.R. 70(8): 1827-1830.

Hidu, H. 1968. Inshore settlement of *Crossostrea virginica* in Delaware Bay. Proc. Nat. Shellfish Assoc. 58: 4.

Hill, D. E. and A. E. Shearin. 1970. Tidal marshes of Connecticut and Rhode Island. Conn. Agr. Exp. Sta. Bull. No. 709. 34 p.

Hill, H. Continental Oil Co. Personal communication with Los Angeles OCS Office, Bureau of Land Management, Department of the Interior.

Holeman, J. N. 1968. The sediment yield of major rivers of the world. Water Resources Research, 4. p. 737-747.

Hollister, C. D. 1973. Atlantic continental shelf and slope of the United States--texture of surface sediments from New Jersey to southern Florida. U. S. Geological Survey Prof. Pap. 529-M. U. S. Department of the Interior, Washington, D. C. 23 p., 2 pl.

Hollister, C. D., J. I. Ewing, D. Habib, J. C. Hathaway, Y. Lancelot. H. Luterbacher, F. J. Paulus, C. W. Poag, J. A. Wilcoxon and P. Worstell. 1972. Sites 105, 106, 107, 108. *In* A. G. Kaneps (ed.) Initial reports of the deep sea drilling project Vol. XI. U. S. Government Printing Office, Washington, D. C. p. 219-364.

Hopper, R. E. 1975. A nationwide survey of resource recovery activities. For the U. S. Environmental Protection Agency (SW-142).

Hoult, D. P. 1972. Oil spreading on the sea. Ann. Rev. Fluid Mechanics. Vol. 4:59-64.

Howe, M. A. 1962. Some direct measurements of non-tidal drift on the continental shelf between Cape Cod and Cape Hatteras. Deep-Sea Res. 9:445-455.

Hufford, G. L. 1971. The biological response to oil in the marine environment. Proj. No. 714141/003. Rep. U. S. Coast Guard. Washington, D. C. 23 p

Hulburt, E. M. 1956. Distribution of phosphorus in Great Pond, Massachusetts. J. Mar. Res. 15(3): 181-192.

Hulburt, E. M. 1957a. The distribution of *Neomysis americana* in the estuary of the Delaware River. Limnol. and Oceanogr. 2(1): 1-11.

Hulburt, E. M. 1957b. The taxonomy of unarmored dinophyceae of shallow embayments in Cape Cod, Mass. Biol. Bull., Woods Hole. 112(2): 196-219.

Hulburt, E. M. 1963. The diversity of phytoplanktonic populations in oceanic, coastal, and estuarine regions. J. Mar. Res. 21(2): 81-93.

Hulburt, E. M. 1965. Flagellates from brackish waters in the vicinity of Woods Hole, Mass. J. Phycol. 1(2): 87-94.

Hulburt, E. M. 1966. The distribution of phytaplankton and its relationship to hydrography, between southern New England and Venezuela. J. Mar. Res. 24(1):67-81.

Hulburt, E. M. 1970. Competition for nutrients by marine phytoplankton in oceanic, coastal and estuarine regions. Ecol. 51 (3): 475-84.

Hulburt, E. M. and J. Rodman. 1963. Distribution of phytoplankton species with respect to salinity between the coast of southern New England and Bermuda. Limnol. Oceanogr. 8(2): 263-269.

Hulings, H. C. 1971. Proceedings of the first international conference on meiofauna. Smithsonian Contributions to Zoology No. 76.

Hustedt, F. 1955. Marine littoral diatoms of Beaufort, North Carolina. Duke Univ. Mar. Sta. Bull. No. 6: 1-67.

Hutchins, L. 1947. The basis for temperature zonation in geographical distribution. Ecol. Monogr. 17: 325-335.

Interstate Sanitation Commission. 1975. Phase I. Report of technical alternatives to ocean disposal of sludge in the New York City-New Jersey metropolitan area.

Iselin, C. O'D. 1936. A study of the circulation of the western North Atlantic. Pap. Phys. Oceanogr. and Meteor. 4(4). 101 p.

Jablonski, L. A. 1968. Ground water resources of Monmouth County, New Jersey. Special Report No. 23. New Jersey Department of Environmental Protection. Trenton, New Jersey. 117 p., 3 pl.

Jacobs, W. C. 1968. The seasonal apportionment of precipitation over the ocean. *In* A. Court (ed.) Electric Climatology, Oregon State Univ. Press. 63-78.

Jacobson, M. K. 1955. Observations on *Donax fossor* at Rockaway Beach, New York. Nautilus 68: 73-77.

Jeffery, P. G. 1973. Large-scale experiments on the spreading of oil at sea and its disappearance by natural factors. *In* Proceedings of the joint conference on prevention and control of oil pollution. Sponsored by EPA, API, and USGS, p. 469-474.

Jeffries, H. P. 1962a. Salinity-space distribution of the estuarine capepod genus *Eurytemora*. Int. Rev. Der. Gesamten Hydrobiologie. 47: 291-300.

Jeffries, H. P. 1962b. Succession of two *Acartia* species in estuaries. Limnol. Oceanogr. 7: 354-364.

Jeffries, H. P. 1962c. Copepod indicator species in estuaries. Ecol. 43(4): 730-733.

Jeffries, H. P. 1962d. Environmental characteristics of Raritan Bay, a polluted estuary. Limnol. Oceanogr. 7(1). p. 21-31.

Jeffries, H. P. 1962e. Environmental characteristics of Raritan Bay. Bull. Bingham Oceanogr. Coll. 13(3): 5-39.

Jeffries, H. P. 1964. Comparative studies on estuarine zooplankton. Limnol. Oceanogr. 9:348-358.

Jeffries, H. P. 1967. Saturation of estuarine zooplankton by congeneric associates. *In* G. Lauff (ed.) Estuaries. AAAS, Washington, D.C. p. 500-508.

Jeffries, H. P. 1969. Seasonal composition of temperate plankton communities: free amino acids. Limnol. Oceanogr. 15(3): 419-426.

Jeffries, H. P. and L. Alzara. 1970. Dominance-diversity relationships of the free amino acids in coastal zooplankton. Comp. Biochem. Physiol. 37: 215-223.

Jeffries, H. P. and W. C. Johnson. 1973. Distribution and abundance of zooplankton, p. 4-1 to 4-93. *In* S. Saila (ed.) Coastal and offshore environmental inventory Cape Hatteras to Nantucket shores. Univ. of Rhode Island, Kingston.

Jenny, M. and J. Goodman (eds.). 1975. A study of the socio-economic factors relating to the outer continental shelf of the mid-Atlantic coast. Vol. 7. College of Marine Sciences, Univ. of Delaware.

Jerome, W. C. Jr., A. Chesmore, C. Anderson and F. Grice. 1965. A study of the marine resources of the Merrimack River estuary. Mass. Div. Mar. Fish. Monogr. No. 1.

Johnson, D. S. and L. H. York. 1915. The relation of plants to tide levels. Carnegie Inst. Wash. Publ. 206: 162 p.

Jones, J. and S. Williams. 1973. Trace elements in the bottom sediments of the OEI study area. In The Gulf Universities Research Consortium-petroleum and allied industry sponsored offshore ecology investigation. Third quarterly scientific report, GURC Report No. 126.

Jordan, R. R. 1968. Suspended and bottom sediments in the Delaware estuary. Geol. Soc. America, Abstr. for 1968. Spec. Pap. 121: 357-358.

Jordan, R. R. and Spoljaric, N. 1966. Generalized geologic map of Delaware. Delaware Geological Survey, Newark, Delaware.

Juge, D. M. 1971. A study of the bacterial population of bottom sediments in the Santa Barbara Channel after the oil spill. In D. Straughan (ed.) Biological and oceanographic survey of the Santa Barbara Channel oil spill, 1969-1970. Allan Hancock Foundation, Univ. of Southern California, Los Angeles.

Kash, Don. E., et al. 1973. Energy under the oceans, a technology assessment of outer continental shelf oil and gas operations. Univ. of Oklahoma Press, Norman.

Kator, H., C. H. Oppenheimer and R. J. Miget. 1971. Microbial degradation of a Louisiana crude oil in closed flasks and under simulated field conditions. In Proceedings of joint conference on pollution and control of oil pollution. Sponsored by EPA, API, and USGS. p. 287-296.

Kawamura, T. 1966. Distribution of phytoplankton populations in Sandy Hook Bay and adjacent areas in relation to hydrographic conditions in June 1962. U. S. Bur. Sports Fish. and Wildl., Tech. Pap. No. 1: 1-37.

Kaye, C. A. and E. S. Barghoorn. 1964. Late quartenary sea level change and crustal rise at Boston, Massachusetts, with notes on autocompaction of peat. Geol. Soc. of America Bull. 75(1): 63-80.

Kelley, C. M. 1973. Crime in the United States, uniform crime reports. Federal Bureau of Investigation, U. S. Department of Justice, Washington, D. C. 282 p.

Kent County (Maryland) Planning Commission. 1974. Comprehensive Plan. Chestertown, Maryland. 135 p.

Kent County Planning and Zoning Office. 1971. Comprehensive Plan. Dover, Delaware. 124 p.

Kester, D. R. and R. A. Courant. 1973. Chemical Oceanography. In Coastal offshore environmental inventory. Univ. of Rhode Island. Marine Publ. Series No. 2. p. 2-1,2-36.

Ketchum, B. H. 1951. The flushing of tidal estuaries. Sewage Industrial Wastes. 23(2): 198-209.

Ketchum, B. H. 1952. The distribution of salinity in the estuary of the Delaware River. WHOI Ref. No. 52-103. 52 p.

Ketchum, B. H. 1970. Ecological effects of sewer sludge disposal at sea. Paper presented at the Water Pollution Control Federation Convention. Session No. 16, Boston.

Ketchum, B. H. 1973. Oil in the marine environment. In Background papers for a workshop on inputs, fates, and effects of oil in the marine environment. Vol. II. Prepared under the aegis of the Ocean Affairs Board, National Academy of Sciences, Washington, D. C.

Ketchum, B. H., A. C. Redfield and J. C. Ayers. 1951. The oceanography of the New York Bight. Pap. Phys. Oceanogr. and Meteor. 12(1). 46 p.

Ketchum, B. H. and D. J. Keen. 1955. The accumulation of river water over the continental shelf between Cape Cod and Chesapeake Bay. Deep-Sea Res. Supp. to Vol. 3: 346-357.

Ketchum, B. H., R. F. Vaccaro and N. Corwin. 1958. The annual cycle of phosphorous and nitrogen in New England coastal waters. J. Mar. Res. 17. p. 282-301.

Ketchum, B. H. and N. Corwin. 1964. The persistence of "winter" water on the continental shelf south of Long Island, N. Y. Limnol. and Oceanogr. 9: 467-475.

King, J. E. 1964. Seals of the world. British Museum of Natural History, London. 154 p.

Kirk, J. M. 1939. The weather and climate of Connecticut. Conn. Geol. Nat. History Survey, Bull. 61. 242 p.

Klemas, V., J. F. Borchardt and W. M. Treasure. 1973. Suspended sediment observations from ERTS-1. Remote Sensing of the Environ. 2:205-221.

Klemas, V., D. Maurer, W. Leathem, P. Kinner and W. Treasure. 1974. Dye and drogue studies of spoil disposal and oil dispersion. J. Water Poll. Control. 46(8): 2026-2034.

Knott, S. T. and H. Haskins. 1968. Evidence of Pleistocene events in the structure of the continental shelf off the northeastern United States. Mar. Geol. 6: 5-43.

Kohler, A. C. and D. N. Fitzgerald. 1969. Comparison of food of cod and haddock in the Gulf of St. Laurence and in the Nova Scotia Banks. J. Fish. Res. Bd. Can. 26(5): 1273-1287.

Kolpack, R. L. 1971. Biological and oceanographical survey of the Santa Barbara Channel oil spill, 1969-1970. Vol. II. Physical, chemical, and geological studies. Allan Hancock Foundation. USCLA. 477 p.

Kolpack, R. L., B. J. Mechalas, T. J. Meyers, N. B. Plutack and E. Easton. 1973. Fate of oil in a water environment. Phase I. API No. 4212. Division of Environmental Affairs, American Petroleum Institute. 28 p.

Koppelman, Lee E. 1974. A methodology to achieve the integration of coastal zone science and regional planning. Nassau-Suffolk Regional Planning Board. 116 p.

Kraft, J. C. 1971. Sedimentary facies patterns and geologic history of a Holocene transgression. Geol. Soc. Amer. Bull. 82: 2131-2158.

Kraft, J. C., R. E. Sheridan and M. D. Maisano. 1971. Time stratigraphic units and petroleum entrapment models in Baltimore Canyon basin of Atlantic continental margin geosynclines. Amer. Assoc. Petrol. Geol. Bull. 55(5): 658-679.

Kreider, R. E. 1971. Identification of oil leaks and spills. In Proceedings of joint conference on prevention and control of oil spills. Sponsored by EPA, API, and USGS. p. 119-124.

Krout, J. E. 1971. Pigment and pigment ratio (430 NM/665 NM). Distributions in several marine environments. Univ. Rhode Island, M.S. Thesis. 120 p.

Kuhnhold, W. W. 1969. Effect of water soluble substances of crude oil on eggs and larvae of cod and herring. Copenhagen, International Council for the Exploration of the Sea, Fisheries Improvement Committee. 15 p.

Lackey, J. B. 1940. Some new flagellates from the Woods Hole area. Amer. Midl. Nat. 23(2): 463-471.

Lackey, J. B 1961. Bottom sampling and environmental niches. Limnol. and Oceanogr. 6(3): 271-279.

Lackey, J. B. 1963. The microbiology of a Long Island Bay in the summer of 1961. Int. Rev. Hydrobiol. 48(4): 577-601.

Lackey, J. B. 1967. The microbiota of estuarines and their roles. In Lauff, G. (ed.) Estuaries. AAAS Publ. No. 83: 291-302.

Landsberg, Hans H. 1968. Energy in the United States. Random House, New York.

Lassiter, J. B. III, R. J. Powers and J. W. Devanney, III. 1974. The role of mass transport in oil slick weathering. *In* Primary physical impacts of offshore petroleum developments. Report No. MITSG 74-20. MIT, Cambridge, Massachusetts. 43 p.

Lebida, R. 1969. The seasonal abundance and distribution of eggs, larvae and juvenile fishes in the Weweantic River estuary, Massachusetts, 1966. M. S. Thesis, Univ. of Massachusetts. 38 p.

LeBoeuf, B. J. 1971. Oil contamination and elephant seal mortality: a "negative" finding. *In* D. Straughan (ed.). Vol. 1. Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill 1969-1970. Allan Hancock Foundation, Univ. of Southern California, Los Angeles.

Lee, R. E. 1944. A quantitative survey of the invertebrate fauna in Menemsha Bight. Biol. Bull. 86: 83-97.

Lee, R. F., R. Sauerheber and A. A. Benson. 1972. Petroleum hydrocarbons: uptake and discharge by the marine mussel. *Mytilus edulis*. Science 177: 201-208.

Leim, A. H. and W. B. Scott. 1966. Fishes of the Atlantic coast of Canada. Fish. Res. Bd. Can. Bull. No. 155.

Levandowsky, M. 1972. An ordination of phytoplankton populations in ponds of varying salinity and temperature. Ecol. 53: 398-407.

Levorsen, A. I. 1967. Geology of Petroleum, 2nd Ed. San Francisco, Cal. 724 p.

Lewis, R. D. 1970. A bibliography of the lobster, genus Homarus. U. S. Fish and Wildl. Serv. Sp. Sci. Report. Fisheries 591. 48 p.

Little, Arthur D., Inc. 1973. Potential onshore effects of deepwater oil terminal-related industrial development. Vols. I-IV. Prepared for the Council on Environmental Quality. National Technical Information Service, Springfield, Virginia.

Long Island Marine Wetlands--status, value and preservation potentials. 1972. Office of Planning Services, Metropolitan New York District Office, New York. 60 p.

Loosanoff, V. L. and C. A. Nomejko. 1951. Existence of physiologically different races of oysters, *Crassostrea virginica*. Biol. Bull., Woods Hole 101(2): 151-156.

Lovejoy, Wallace F. 1967. Economic Aspects of oil conservation regulation. Johns Hopkins Press, Baltimore.

Loveland, R. E. 1972. Invertebrates. *In* Progress report No. 8, the qualitative and quantitative analysis of the benthic flora of Barnegat Bay before and after the onset of thermal addition, Mimeo, Rept. Rutgers Univ.

Ludwick, J. C. 1972. Migration of tidal sand waves in Chesapeake Bay entrance. *In* D. J. P. Swift, D.B. Duane and O. H. Pilkey (eds.) Shelf sediment transport. Dowden, Hutchinson, and Ross, Inc., Stroudsburg, Pa. p. 377-410.

Lux, F. E. and F. E. Nichy. 1971. Number and lengths by season of fishes caught with an otter trawl near Woods Hole, Mass., September 1961 to December 1962. U. S. Dept. Comm. Spec. Sci. Rept. Fish No. 662: 1-15.

Lynde, R. E. 1973. Physical Oceanography (Tides). *In* Coastal and offshore environmental inventory--Cape Hatteras to Nantucket shoals. Mar. Publ. Ser. No. 2. Univ. Rhode Island: 1-46--1-61.

MacIntyre, W. G., C L. Smith, J. C. Munday, V. M. Gibson, J. L. Lake, J. G. Windsor, J. L. Dupuy, W Harrison and J. D. Oberholtzer. 1974. EPA 6701/2-73-099. Office of Research and Development. U.S. EPA. Washington, D. C. 168 p.

MacKenzie, C. L. 1970a. Oyster culture in Long Island Sound 1966-1969. Comm. Fish. Rev. 32(1): 27-40.

MacKenzie, C. L. 1970b. Causes of oyster spot mortality, conditions of oyster setting beds and recommendations for oyster bed management. Proc. Nat. Shellfish Assoc. 60: 59-67.

Mackin, J. G. 1950a. A comparison of the effect of application of crude petroleum to marsh plants and to oysters. Texas A & M Research Foundation.

Mackin, J. G. 1950b. Report on a study of the effect of application of crude petroleum on saltgrass, *Distychlis spicata*. Texas A & M Research Foundation.

Maher, J. C. 1965. Correlations of subsurface Mesozoic and Cenozoic rocks along the Atlantic coast. Amer. Assoc. Petrol. Geol. Cross Sec. Publ. 3. 18 p

Maher, J. C. 1971. Geologic framework and petroleum potential of the Atlantic coastal plain and continental shelf. USGS Prof. Pap. 59. U. S. Department of the Interior, Washington, D. C. 98 p.

Mandelli, E. F., T. E. Burkholder, T. E. Doheny and J. Brody. 1970. Studies of primary productivity in coastal waters of southern Long Island, New York. Mar. Biol. 7(2): 153-160.

Manheim, F. T., R. H. Meade and G. C. Bond. 1970. Suspended matter in surface waters of the Atlantic continental margin from Cape Cod to the Florida Keys. Science 167. p. 371-376.

Manly, J. O. 1953. Marine and brackish water diatoms of Beaufort, North Carolina. Ph. D. Thesis, Duke Univ. 175 p.

Marak, R. R. 1960. Food habits of larval cod, haddock and codfish in the Gulf of Maine and Georges Bank area. J. Cons. Perm. Int. Explor. Mer. 25(2): 147-157.

Marcus, S. J. (coordinator). 1973. Environmental conditions within specified geographical regions offshore east and west coasts of the United States and in the Gulf of Mexico. U. S. Dept. of Commerce Publ. 735 p.

Marine Ecosystems Analysis Program. 1974. Bibliography of the New York Bight, Part I--List of Citations. NOAA Office of Coastal Environment. Rockville, Maryland. 184 p.

Marine Ecosystems Analysis Program. 1974. Bibliography of the New York Bight, Part 2--Indexes. NOAA Office of Coastal Environment. Rockville, Maryland. 493 p.

Marine Ecosystems Analysis Program 1975. Ocean dumping in the New York Bight. NOAA Technical Report ERL 321-MESA2. Boulder, Colorado. 78 p.

Marr, J. C. 1956. The "critical period" in the early life history of marine fishes. J. du Conseil., Vol. 2, No. 2.

Marsh, G. A. 1970. A seasonal study of *Zostera* epibiota in the New York Basin, Virginia. Ph.D. Thesis. College of William and Mary. 155 p.

Marshall, N. 1960. Studies of the Niantic River, Connecticut with special reference to the bay scallop, *Acquipecten irradians*. Limnol. and Oceanogr. 5(1): 86-105.

Marshall, N. 1967. Some characteristics of the epibenthic environment of tidal shoals. Ches. Sci. 8(3): 155-169.

Marshall, N. 1970. Food transfer through the lower trophic levels of the benthic environment, p. 52-66. *In* J. Steele (ed.) Marine food chains. Univ. of Calif. Press, Berkeley. 552 p.

Marshall, N. and B. W. Wheeler. 1965. Role of the coastal and upper estuarine waters contributing phytoplankton to the shoals of the Niantic estuary. Ecol. 46(5): 665-673.

Marshall, N. and K. Lukas. 1969. Preliminary observations on the properties of bottom sediments with and without eelgrass, *Zostera marina*, cover, Proceed. Nat. Shellfish. Assoc. 60: 107-111.

Martin, G. W. 1929. Dinoflagellates from marine and brackish waters of New Jersey. Univ. Iowa Stud. Nat. Hist. 12(9): 1-32.

Martin, G. W. and T. C. Nelson. 1929. Swarming of dinoflagellates in Delaware Bay, New Jersey. Bot. Gaz. 88(2): 218-224.

Martin, J. H. 1965. Phytoplankton-zooplankton relationships in Narragansett Bay. Limnol. Oceanogr. 10(2): 185-191.

Martin, J. H. 1968. Phytoplankton-zooplankton relationships in Narragansett Bay. III. Seasonal changes in zooplankton excretion rates in relation to phytoplankton abundance. Limnol. Oceanogr. 13(1): 63-71.

Martin, J. H. 1970. Phytoplankton-zooplankton relationships in Narragansett Bay. IV. The seasonal importance of grazing. Limnol. Oceanogr. 15(3): 413-418.

Martin. W. E. 1959. The vegetation of Island Beach State Park, New Jersey. Ecol. Monogr. 29: 1-46.

Maryland outdoor recreation and open space comprehensive plan: Phase II. 1972. Departments of State Planning and Natural Resources, State of Maryland, Annapolis.

Massachusetts Institute of Technology. 1973. Offshore oil task group report, Georges Bank petroleum study, MITSG 73-5, MIT, Cambridge.

Mattick, R. E., R. Q. Foote, N. L. Weaver and M. S. Grim. 1974. Structural framework of United States Atlantic outer continental shelf north of Cape Hatteras. Amer. Assoc. Petrol. Geol. Bull. 58(6): 1179-1190.

Mauer, D., L. Watling and R. Keck. 1971. The Delaware oyster industry: a reality. Trans. of the Amer. Fish. Soc. 100(1): 100-111.

McAuliffe, Clayton. 1966. Solubility in water of paraffin, cycloparaffin, olefin, acetylene, cycloolefin and aromatic hydrocarbons. J. Physical Chemistry. Vol. 70. p. 1267-1275.

McAuliffe, Clayton D. 1974. Determination of C_1-C_{10} hydrocarbons in water. NBS Spec. Publ. 409, Marine Pollution Monitoring (Petroleum). p. 121-125.

McAuliffe, C. D., A. E. Smalley, R. D. Groover, W. M. Welsh, W. S. Pickle and G. E. Jones. 1971. Chevron Main Pass Block 41 oil spill: chemical and biological investigations. In Proceedings of the joint conference on prevention and control of oil pollution. Sponsored by EPA, API and USGS. p. 555-566.

McCleave, J. 1972. Survey of the hydrography, sediments, plankton, benthos and commercially important plants and animals, including finfish, in the Montsweag Bay-Back River area. V. Finfish. Univ. Maine, Ira C. Darling Center.

McClelland, B. 1975. Geologic engineering properties related to construction of offshore facilities on the mid-Atlantic continental shelf. In L. G. Cronin and R. E. Smith, (eds.) Marine environmental implications of offshore oil and gas development in the Baltimore Canyon region of the mid-Atlantic coast. Estuarine Research Federation, Wachapreague, Virginia. p. 271-242.

McClennon, C. E. 1973. New Jersey continental shelf near bottom current meters records and recent sediment activity. J. Sed. Petrol. 43(2): 371-380.

McDonald, Stephen L. 1971. Petroleum conservation in the United States: an economic analysis. Johns Hopkins Press, Baltimore.

McGinnis, D. R. 1971. Observations on the zooplankton of the eastern Santa Barbara Channel from May 1969 to March 1970. In D. Sraughan (ed.) Biological and oceanographic survey of the Santa Barbara Channel oil spill, 1969-1970. Allan Hancock Foundation, Univ. Southern California, Los Angeles.

McHugh, J. J. 1967. Estuarine nekton, p. 581-620. In G. H. Lauff (ed.) Estuaries. Amer. Assoc. Advance Sci. Washington, D. C.

McIntyre, A. D. 1968. Ecology of marine meiobenthos. Biol. Rev. 44: 245-290.

McKinney, T. F. W. L. Stubblefield and D. J. P. Swift. 1974. Large scale current lineations on the Great Egg shoal retreat massif, New Jersey shelf: investigations by sidescan sonar. Marine Geology. 17: 79-102.

McLellan, H. J. 1957. On the distinctness and origin of the slope water off the Scotian shelf and its easterly flow south of the Grand Banks. J. Fish. Res. Bd. Can. 14(2): 213-239.

Meade, R. H. 1969. Landward transport of bottom sediments in estuaries of the Atlantic coastal plain. J. Sed. Petrol. 39: 222-234.

Meade, R. H., P. L. Sachs, F. T. Manheim, J. C. Hathaway and D. W. Spencer. 1975. Sources of suspended matter in waters of the middle Atlantic Bight. J. Sed. Petrol. 45(1): 171-188.

Meisburger, E. P. 1972. Geomorphology and sediments of the Chesapeake Bay entrance. U. S. Army Corps of Engineers Coastal Engineering Research Center, Tech. Memo. No. 38, Fort Belvoir, Virginia. 61 p.

Menzel, R. W. 1948. Report on two cases of "oily tasting" oysters at Bay Ste. Elaine Oilfield. Texas A & M Research Foundation.

Menzies, R. J., R. Y. George and G. T. Rowe. 1973. Abyssal environment and ecology of the world's oceans. John Wiley and Sons, Inc. 487 p.

Merrill, A. S. 1962. Abundance and distribution of sea scallops off the middle Atlantic coast. Proc. Nat. Shellfish Assoc. 51: 74-80.

Merrill, A. S. and J. W. Rapes. 1967. Distribution of southern quahogs off the middle Atlantic coast. Comm. Fish. Rev. 29(4): 62-64.

Merriman, D. 1941. Studies on the striped bass (*Roccus saxatilis*) of the Atlantic coast. Fish. Bull. U. S. 50(35): 1-77.

Merriman, D. and R. C. Sclar. 1952. The pelagic fish eggs and larvae of Block Island Sound. Bull. Bingh. Oceanogr. Coll. 13(3): 165-219.

Merriman, D. and H. Warfel. 1948. Studies on the marine resources of southern New England. VII. Analysis of a fish population. Bull. Bingh. Oceanogr. Coll. Vol. XI Art. 4, 131-164.

Metzgar, R. G. 1973. Wetlands in Maryland. Depart. of State Planning, Baltimore, Maryland.

Middlesex County Planning Board (M. D. Flannery--personal communication, June 20, 1975). Population projections and system indicators for Middlesex County, New Jersey, New Brunswick, New Jersey.

Miller, A. R. 1950. A study of mixing processes over the edge of the continental shelf. J. Mar. Res. 9: 145-160.

Miller, A. R. 1952. A pattern of surface coastal circulation inferred from surface salinity--temperature data and drift bottle recoveries. WHOI Ref. No. 52-28. 14 p.

Miller, B. J. 1937. Geophysical investigations in the emerged and submerged Atlantic coastal plain, Part 2: geological significance of the geophysical data. Geol. Soc. America Bull. 48: 803-812.

Miller, B. J., Harry L. Thomsen, and Gordon L. Dolton. 1975. Geological estimates of undiscovered recoverable oil and gas resources in the United States. USGS Circ. 725. U. S. Department of the Interior, Washington, D. C. 78 p.

Miller, J. C. 1971. Ground water geology of the Delaware Atlantic onshore. Report of Invest. No. 17. Delaware Geological Survey, Newark, Delaware. 33 p.

Miller, W. R. and F. E. Egler. 1950. Vegetation of the Wequetequock-Pawcatuck tidal marshes, Connecticut. Ecol. Monogr. 20: 143-172.

Miller, W. S., E. M. Wallace, C. N. Shuster, Jr., and R. E. Hillman. 1970. Hard clam, the gourmet's delight. Mar. Res. of the Atlantic Coast leaflet 14. 8 p.

Milliman, J. D. 1972. Atlantic continental shelf and slope of the United States--petrology of the sand fraction of sediments, northern New Jersey to southern Florida. USGS Prof. Pap. 529-J. U. S. Department of the Interior, Washington, D. C. 40 p., 9 pl.

Milliman, J. D. 1974. Marine geology of the middle Atlantic Bight. Mar. Publ. Series No. 3. Univ. Rhode Island. 89 p.

Milliman, J. D. and K. O. Emery. 1968. Sea levels during the past 35,000 years. Science. 162: 1121-1123.

Milliman, J. D., O. H. Pilkey and D. A. Ross. 1972. Sediments of the continental margin off the eastern United States. Geol. Soc. America Bull. 83: 1315-1333.

Mills, E. L. 1967. The biology of an Ampeliseid amphipod crustacean sibling species pair. J. Fish Res. Bd. Can. 24: 305-354.

Mills, E. L. 1969. The community concept in marine zoology with comments on continua and instability in some marine communities. J. Fish. Res. Bd. Can. 26: 1415-1428.

Minard, J. P., W. J. Perry, E. G. A. Weed, E. C. Rhodehamel, E. I. Robbins and R. B. Mixon. 1974. Preliminary report on geology along Atlantic continental margin of northeastern United States. Amer. Assoc. Petrol. Geol. Bull. 58: 1169-1178.

Miner, R. W. 1950. Field guide to seashore life. Van Rus., New Jersey. 888 p.

Mironov, O. G. 1969. Effects of low concentrations of petroleum and its products on the development of roe of the Black Sea flatfish. Vop. Ikhtiol. 7(3): 577-580.

Mironov, O. G. 1970. The effect of oil pollution on flora and fauna of Black Sea. Paper presented at Food and Agri. Org. Conf., Rome, Italy. December.

Mironov, O. G. 1972. Effect of oil pollution on flora and fauna of Black Sea. In Marine pollution and sea life, FAO, London. p. 222-224.

Mironov, O. G. and L. A. Lanskaya. 1969. Growth of marine microscopic algae in seawater contaminated with hydrocarbons. Biologiya Morya 17: 31-38.

Moeller, H. W. 1964. A standing crop estimate of some marine plants in Barnegat Bay. The Bulletin, New Jersey Acad. Sci. 9: 27-30.

Monmouth County (New Jersey) Planning Board. 1969. General Development Plan, 1969-1985, Monmouth County. Freehold, New Jersey. 105 p.

Monmouth County (New Jersey) Environmental Council. 1974. 1973 Environmental Quality Index, Monmouth County, New Jersey. Freehold, New Jersey 55 p.

Moody, D. W. 1964. Coastal morphology and processes in relation to the development of submarine sand ridges off Bethany Beach, Delaware. Johns Hopkins University, Baltimore, Maryland. Unpub. Ph.D. dissertation. 167 p.

Moore, J. C. 1953. Distribution of marine mammals to Florida waters. American Midland Naturalist. 49: 117-158.

Moore, J. C. 1966. Diagnosis and distribution of Beaked Whales of the genus Mesoplodon known from North American waters, p. 79-113. In K. S. Norris (ed.) Whales, dolphins and porpoises. Univ. California Press, Los Angeles and Berkeley. 16: 789 p.

Moore, S. F., G. R. Chirlin, C. J. Puccia and B. P. Schrader. 1974. Potential biological effects of hypothetical oil discharges in the Atlantic coast and Gulf of Alaska. Report No. MITSG 74-19. MIT, Cambridge, Massachusetts. 121 p.

Moore, S. F., R. L. Dwyer and A. M. Katz. 1973. A preliminary assessment of the environmental vulnerability of Machias Bay, Maine to oil supertankers. T. R. #162. Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics. MIT, Cambridge, Massachusetts.

Mordoff, R. A. 1949. The climate of New York State. Ithaca, New York State Coll. Agriculture. Cornell Extension Bull. 764.

Morgan, C. W. and M. G. Compton. 1974. A weekly surface current chart for search and rescue in the northwest Atlantic. U. S. Coast Guard Oceanographic Unit. Washington, D. C.

Morrow, J. E. 1974. Effects of crude oil and some of its components on young coho and sockeye salmon. EPA Ecol. Res. Sci. 37 p.

Mountford, K. 1967. The occurrence of pyrrophyta in a brackish cove: Barnegat Bay, New Jersey at Mantoloking, May through December 1966. N. J. Acad. Sci. Bull. 12(1): 9-12.

Mueller, J. and J. Jeris. 1975. Contaminant inputs to the New York Bight. NOAA/MESA Grant No. 04-4-002-34. Draft.

Mulford, R. A. 1963. Distribution of the dinaflagellate genus *Ceratium* in the tidal and offshore waters of Virginia. Ches. Sci. 4(2): 84-89.

Mulford, R. A. 1964. Investigations of inner continental shelf waters off lower Chesapeake Bay. V. Seasonality of the diatom genus *Chaetoceros*. Limnol. Oceanogr. 9(3): 385-390.

Mulford, R. A. and J. J. Norcross. 1971. Species composition and abundance of net phytoplankton in Virginian coastal waters, 1963-1964. Ches. Sci. 12(3): 142-155.

Murphy, T. A. 1971. Environmental effects of oil pollution. J. Sanitary Engineering Div., Proc. Am. Soc. Curl Engineers. 97(SA3): 361-371.

Murray, G. E. 1961. Geology of the Atlantic and Gulf coastal province of North America. Harper and Brothers, New York. 692 p.

Nagle, J. S. 1965. Distributional aspects of the Cape Cod eelgrass epibiota. Biol. Bull. 129: 417.

Nagle, J. S. 1968. Distribution of the epibiota of macroepibenthic plants. Contrib. Mar. Sci. Univ. Texas. 13: 105-144.

Nassau County Museum. 1971. Indian archaeology of Long Island. Nassau County Museum Educational Leaflet 17, Glen Cove, New York 8 p.

National Academy of Sciences. 1975. Petroleum in the marine environment. Workshop on inputs, fates and the effects of petroleum in the marine environment. Washington, D. C. 107 p.

National Marine Fisheries Service. 1970. Fishery statistics of the United States, 1970. U. S. Department of Commerce, NOAA. 489 p.

National Marine Fisheries Service. 1971. Fishery statistics of the United States, 1971. U. S. Department of Commerce, NOAA. 424 p.

National Marine Fisheries Service. 1972. The effects of waste disposal in the New York Bight, Final Report, Sect. 3: Zooplankton studies. Report to Coastal Erg. Res. Ctr. p. 1-30.

National Marine Fisheries Service. 1973. Fisheries of the United States, 1972. U. S. Department of Commerce, NOAA. 101 p.

National Marine Fisheries Service. 1974. Fisheries of the United States, 1973. U. S. Department of Commerce, NOAA. 106 p.

National Marine Fisheries Service. 1975. Fisheries of the United States, 1974. U. S. Department of Commerce, NOAA. 98 p.

National Petroleum Council. 1972. U. S. Energy Outlook. National Petroleum Council, Washington, D. C.

National Oceanic and Atmospheric Administration, 1975. Ocean dumping in the New York Bight, NOAA Tech. Rept. ERL 321-MESA 2. U. S. Department of Commerce, Washington, D. C. 78 p.

National Registry of Natural Landmarks (Revision of List). 1975. Federal Register Vol. 40, No. 87.

National Wildlife Refuge System Public Use Report, 974. (Computer printout). Branch of Operations, Fish and Wildlife Service, U. S. Department of the Interior, Washington, D. C.

Naval Weather Service Environmental Detachment. 1973. Station climatic summary, Lakehurst, New Jersey. Asheville, North Carolina. 2 p.

Nelson, T. C. 1925. On the occurrence and food habits of ctenaphores in New Jersey inland coastal waters. Biol. Bull., Woods Hole. 48(2): 92-111.

Nelson-Smith, A. 1972. Oil pollution and marine ecology. Elek Science, London. 260 p.

Neumann, G. and W. J. Pierson. 1966. Principles of physical oceanography. Prentice-Hall. Englewood Cliffs, New Jersey. 545 p.

Newell, R. C. 1970. Biology of intertidal animals. Amer. Elsevier, New York. 555 p.

New Jersey Open Space Policy Plan. 1968. Division of State and Regional Planning, Department of Community Affairs, State of New Jersey, Trenton.

New York State. 1974. Air quality report/continuous monitoring system. New York State Department of Environmental Conservation. 180 p.

Nichols, J. T. and C. M. Breder, Jr. 1927. The marine fishes of New York and southern New England. Zool. 9(1), 192 p.

Nichols, W. D. 1968. Ground water resources of Essex County, New Jersey Special Report No. 28. New Jersey Department of Environmental Protection, Trenton, New Jersey. 56 p., 3 pl.

Nicholson, N. L. and R. L. Cimberg. 1971. The Santa Barbara oil spill of 1969; a post spill survey of the rocky intertidal. In D. Straughan (ed.) Biological and oceanographic survey of the Santa Barbara Channel oil spill, 1968-1970. Allen Hancock Foundation. Univ. Southern California, Los Angeles.

Niering, W. A. 1961. Tidal marshes, their use in scientific research. Conn. Arboretum Bull. 12: 3-7.

North Atlantic Regional Water Resources Study: water quality and pollution (Appendix L) 1972. 420 p.

North Atlantic Regional Water Resources Study: outdoor recreation (Appendix M) 1972. Bureau of Outdoor Recreation, U. S. Department of the Interior, Phil., Penn.

North, W. J. 1973. Position paper on effects of acute oil spills. In Background papers for a workshop on inputs, fates and effects of oil in the marine environment. Vol. 2. Prepared under the aegis of the Ocean Affairs Board, National Academy of Sciences, Washington, D. C.

North, W. J., M. Neushul Jr., and K. A. Clendenning. 1965. Successive biological changes observed in a marine cave exposed to a large spillage of oil. Symposium commission internationale exploration scientifique Mer Mediterranee, Monaco, 1964. p. 335-354.

Ocean County Planning Board. Personal communication, T. A. Thomas, May 23, 1975. Population projections and system indicators for Ocean County, New Jersey. Toms River, New Jersey

O'Connor, J. S. 1972. The benthic macrofauna of Moriches Bay, New York. Biol. Bull. 142: 84-102.

Officer, C. B. Jr., and M. Ewing. 1954. Geophysical investigations in the emerged and submerged Atlantic coastal plain, Part 7: continental shelf, continental slope, and continental rise south of Nova Scotia. Geol. Soc. America Bull. 66: 653-670.

Oguri, M. and R. Kantor. 1971. Primary productivity in the Santa Barbara Channel. In D. Straughan (ed.) Biological and oceanographic survey of the Santa Barbara Channel oil spill. 1969-1970. Allan Hancock Foundation, U. Southern California, Los Angeles. p. 17-48.

Oliver, J. E., and C. L. Drake. 1951. Geophysical investigations in the emerged and submerged Atlantic coastal plain, Part 6: Long Island area. Geol. Soc. America Bull. 62: 1287-1296.

Omwake, H. G. 1945. Refuse pits in Sinepuxent Neck on the eastern shore of Maryland. Archaeol. Soc. of Delaware Bull. 4(2): 2-13.

Oostdam, B. L., and R. R. Jordan. 1972. Suspended sediment transport in Delaware Bay. In Bruce Nelson (ed.) Geological Soc. of America Memoir 133. Environmental framework of coastal plain estuaries. Boulder, Colorado. p. 143-149.

Open space and recreation report--the eastern shore of Virginia. 1974. Accomack-Northampton Planning District Commission, Accomac, Virginia.

Operation Oil. 1970. Report of the task force--operation oil (cleanup of the Arrow oil spill in Chedabrecto Bay) to the Minister of Transport. Atlantic Oceanogr. Lab. Bendford Inst. Dartmouth, Nova Scotia.

Oross, E. Eugene Associates. For Ocean County (New Jersey) Planning Board. Master plan report 4: natural resources study. 1973. Toms River, New Jersey. 48 p.

Oross, E. Eugene Associates. For Ocean County (New Jersey) Planning Board. Master plan report 5: land use study. 1973. Toms River, New Jersey. 53 p.

Outdoor Recreation on Long Island. 1971. Office Planning Coordination, Metropolitan District Office, State of New York. New York, New York.

Outdoor Recreation in New Jersey: New Jersey Statewide Comprehensive Outdoor Recreation Plan. 1973. Office of Environmental Review, Department of Environmental Protection, State of New Jersey. Trenton, New Jersey.

Outdoor Recreation in a Crowded Region. 1973. Tri-State Regional Planning Commission. New York, New York.

Owens, J. P. and N. F. Sohl. 1969. Shelf and deltaic paleoenvironments in the Cretaceous-tertiary formations of the New Jersey coastal plains. Field trip No. 2. In Geology of selected areas of New Jersey and eastern Pennsylvania and guidebook of excursions. Geol. Soc. America, Annual Meeting, Atlantic City, New Jersey, 1969. Rutgers University Press, New Brunswick, New Jersey. p. 235-278.

Owens, J. P. 1970. Post Triassic tectonic movements in the central and southern Appalachians as recorded by sediments of the Atlantic coastal plain. In G. W. Fisher, F. J. Pettijohn, J. C. Reed, Jr., and K. N. Weaver (eds.) Studies of Appalachian geology, central and southern. Interscience Publishers, New York. p. 417-427.

Paine, R. T. 1969. The Pisaster-tegula interaction: prey patches, predator food preferences and intertidal community structure. Ecol. 50: 950-961.

Paradiso, J. L. and C. O. Handley, Jr. 1965. Checklist of mammals of Assateague Island. Chesapeake Science. 6: 167-171.

Pararas-Carayannis, G. 1973. Ocean dumping in the New York Bight: an assessment of environmental studies. Tech. Memo, No. 39. U. S. Army Corps of Engineers, Coastal Research Center.

Parker, R. H. 1969. Benthic invertebrates in tidal estuaries and coastal lagoons, Lagunas Costeras, on Simposia. Mem. Simp. Intern. Lagunas Coasteras. UNAM-UNESCO, Nov. 28-30, 1967. Mexico, D. F. p. 563-590.

Parker, R. R. and P. A. Larkin. 1959. A concept of growth in fishes. J. Fish. Res. Bd. Can. 16: 721-745.

Parr, A. E. 1933. A geographic-ecological analysis of the seasonal changes in temperature conditions in the shallow water along the Atlantic coast of the U. S. Bull. Bingh. Oceanogr. Coll. Vol. IV, Art. 3. 90 p.

Participation in Marine Recreational Fishing--Northeastern United States, 1973-1974. 1975. Statistics and Market News Division, National Marine Fisheries Service, U. S. Department of Commerce. Washington, D. C.

Patten, B. C. 1961a. Plankton energetics of Raritan Bay. Limnol. Oceanogr. 6(4): 369-387.

Patten, B. C. 1961b. Negentropy flow in communities of plankton. Limnol. Oceanogr. 6(1): 26-30.

Patten, B. C. 1962. Species diversity in net phytoplankton of Raritan Bay. J. Mar. Res. 20(1): 57-75.

Pearce, J. B. 1970. The effects of solid waste disposal on benthic communities in the New York Bight. FAO Tech. Conf. on Mar. Poll., Rome. p. 9-18.

Pearce, J. B. 1972. The effects of waste disposal in the New York Bight. II. Benthic studies. Report to the United States Coastal Engineering Research Center from the National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey.

Pearcy, W. G. 1962. Ecology of young winter flounder in an estuary. Bull. Bingh. Ocean. Coll. Vol. 18 Art. 1. p. 1-78.

Pearcy, W. and S. Richards. 1962. Distribution and ecology of fishes of the Mystic River estuary, Connecticut. Ecol. 43: 248-259.

Pearse, A. S., H. J. Humm and G. W. Wharton. 1942. Ecology of sand beaches at Beaufort, North Carolina. Ecol. Monogr. 12: 135-190.

Pennak, R. W. 1951. Comparative ecology of the intertidal fauna of freshwater and marine beaches. Ann. Biol. 27: 217-248.

People--Resources--Recreation: New York Statewide Comprehensive Recreation Plan. 1972. Office of Parks and Recreation, Department of Environmental Conservation, State of New York. Albany, New York.

Perry, W. J., Jr., J. P. Minard, E. G. A. Weed, E. I. Robbins and E. C. Rhodehamel. 1974. Stratigraphy of the Atlantic continental margin north of Cape Hatteras--a brief survey. USGS Open File Report. U. S. Department of the Interior, Washington, D. C. 49 p.

Petroleum E[illegible]ension Service. 1970. A primer of oilwell drilling. 3rd ed. 95 p.

Petroleum Extension Service. 1973. Oil pipeline construction and maintenance. Vol. II. 2nd ed. 153 p.

Pettibone, M. H. 1963. Maine polychaete worms of the New England region. I. Families Aphroditidae through Trochochaetidae. U. S. Nat. Mus. Bull. 227: 1-356.

Pfitzenmeyer, H. T. 1961. Benthic shoal water invertebrates from tidal waters of Somerset County, Maryland. Ches. Sci. 2: 89-94.

Pfitzenmeyer, H. T. 1970. Gross physical and biological effects of overboard spoil disposal in upper Chesapeake Bay. Project C, Benthos, p. 26-38. In Nat. Resour. Instit. Spec. Rept. No. 3.

Phelps, D. K. 1958. A quantitative study of the infauna of Narragansett Bay in relation to certain physical and chemical aspects of their environment. M. S. Thesis, U. Rhode Island.

Phelps, D. K. 1964. Funct[illegible] relationships of benthos in a coastal lagoon. Ph.D. Thesis, U. of Rhode [illegible]d.

Phillips, F. X. 1971. The benthic invertebrate community of Barnegat Bay, New Jersey, with emphasis on the infauna. M. S. Thesis, Rutgers U. 80 p.

Phillips, O. M. 1966. The dynamics of the upper ocean. Cambridge University Press. New York, New York 261 p.

Phillips, P. H., W. D. Burke and E. J. Keener. 1969. Observations on the trophic significance of jellyfishes in Mississippi Sound with quantitative data on the associative behavior of small fishes with medusae. Amer. Fish. Soc. Trans. 98: 703-712.

Piers, H. 1923. The blue crab (Callinectes sapidus Rathbun): extension of its range northward to near Halifax, Nova Scotia. Proc. Nova Scotian Inst. Sci. 15: 83-90.

Pilson, M. E. and E. Goldstein. 1973. Marine mammals. In S. Saila (ed.) Coastal and offshore environmental inventory, Cape Hatteras to Nantucket shoals. U. Rhode Island, Kingston.

Pollock, L. W. and W. D. Hummond. 1971. Cyclic changes in interstitial water content, atmospheric exposure and temperature in a marine beach. Limnol. Oceanogr. 16: 522-535.

Pomeroy, L., H. H. Haskin and R. A. Ragotzkie. 1956. Observations on dinoflagellate blooms. Limnol. Oceanogr. 1(1): 54-60.

Poole, J. C. 1964. Feeding habits of the summer flounder in Great South Bay, New York. Fish and Game J. 11(1): 28-34.

Port Authority of New York and New Jersey. 1975. Oceanborne foreign trade: lifeblood of the port. Where it comes from, where it goes, how it gets there. New York, New York. 48 p.

Posgay, J. A. 1968. The range of the sea scallop. Nautilus 71(2): 55-57.

Potential Wildlands in Maryland. 1973. Department of Natural Resources, State of Maryland, Annapolis, Maryland.

Pratt, D. M. 1959. The phytoplankton of Narragansett Bay. Limnol. Oceanogr. 4(4): 425-440.

Pratt, D. M. 1965. The winter-spring diatom flowering in Narragansett Bay. Limnol. Oceanogr. 10(2): 173-184.

Pratt, S. D. 1973. Benthic fauna, p. 5-1 to 5-70. In S. Saila (ed.) Coastal and offshore environmental inventory Cape Hatteras to Nantucket shoals. U. Rhode Island, Kingston.

Press, F. and W. C. Beckman. 1954. Geophysical investigations in the emerged and submerged Atlantic coastal plain, Part 8: Grand Banks and adjacent shelves. Geol. Soc. America Bull. 65: 299-314.

Pritchard, D. W., A. Okubo and E. Mehr. 1962. A study of the movement and diffusion of an introduced contaminant in New York harbor waters. Chesapeake Bay Inst. Tech. Rept. 31. Ref. 62-21. 89 p.

Public Use of the National Parks. 1974. Prepared by the National Park Service, U. S. Department of the Interior, published by U. S. Travel Data Center, Washington, D. C.

Quayle, Robert G. 1974. Climatic comparison of ocean weather stations and transient ship records. In Mariners Weather Log. Vol. 18, No. 5. p. 307-311.

Rao, P. K., A. E. Strong and R. Koffler. 1971. Gulf stream meanders and eddies as seen in satellite infrared imagery. J. Phys. Oceanogr. 1: 237-239.

Rawles, C. K. 1965. Field tests of herbicide toxicity to certain estuarine animals. Ches. Sci. 6: 150-161.

Raymont, J. 1966. The production of marine plankton. In J. B. Gragg (ed.) Advances in ecological research. Academic Press. p. 117-205.

Rebman, Ronald J. 1973. For Rappahannock Area Development Commission. The next challenge: creating contemporary communities. Fredericksburg, Virginia. 79 p.

Redfield, A. C. 1958. The influence of the continental shelf on the tides of the Atlantic coast of the United States. J. Mar. Res. 17: 432-448.

Rees, G. H. 1969. Edible crabs of the United States. Bur. of Comm. Fish., Fish. Leaflet No. 550. 18 p.

Reisbig, R. L. 1973. Oil spill drift caused by the coupled effects of wind and waves. Report No. DOT-CG-24603-A-4. U. S. Department of Transportation. Coast Guard. Washington, D. C. 61 p.

Reisbig, R. L., D. J. Alofs, R. C. Shah and S. K. Banerjee. 1973. Measurement of oil spill drift caused by the coupled parallel effects of wind and waves. Memoires Societe Royale des Sciences de Liege. 6^{e} serie. tome VI: 67-77.

Rhodehamel, E. C. 1970. A hydrologic analysis of the New Jersey Pine barrens region. Water Resources Circular No. 22. New Jersey Department of Environmental Protection. Trenton, New Jersey. 35 p.

Rice, D. W. and V. B. Scheffer. 1968. A list of the marine mammals of the world. U. S. Fish and Wildlife Service, Spec. Sci. Report, Fisheries No. 579. p. 1-16.

Richards, H. G. 1932. Notes on the marine algae of New Jersey. Bartonia 13: 38-46.

Richards, H. G., F. H. Olmsted and J. L. Ruhle. 1962. Generalized structure contour maps of the New Jersey coastal plain. Geologic Report Series No. 4. New Jersey Geol. Survey. Trenton, New Jersey. 38 p.

Richards, S. W. 1963. The demersal fish population of Long Island Sound. Bull. Bing. Oceanogr. Coll. Vol. 18, Art. 2. 101 p.

Ricker, W. E. 1946. Production and utilization of fish populations. Ecol. Monogr. 16: 373-392.

Riley, G. A. 1939. Plankton studies. II. The western North Atlantic, May-June 1939. J. Mar. Res. 2(2): 145-162.

Riley, G. A. 1947. Seasonal fluctuations of the phytoplankton population in New England coastal waters. J. Mar. Res. 6(1): 33-47.

Riley, G. A. 1952a. Hydrography of the Long Island and Block Island Sounds. Bull. Bingham Oceanogr. Coll. 8(3): 6-39.

Riley, G. A. 1952b. Phytoplankton of Block Island Sound, 1949. Bull. Bingham Oceanogr. Coll. 13(2): 40-64.

Riley, G. A. 1955. Review of the oceanography of Long Island Sound. Deep-Sea Res. Suppl. 3: 224-238.

Riley, G. A. 1956. Oceanography of Long Island Sound, 1952-1954. II. Physical oceanography. Bull. Bingham Oceanogr. Coll. 15: 15-46.

Riley, G. A. 1956. Oceanography of Long Island Sound, 1952-1954. IX. Production and utilization of organic matter. Bull. Bingh. Oceanogr. Coll. 15: 324-344.

Riley, G. A. 1959. Environmental control of autumn and winter diatom flowerings in Long Island Sound. In Sears, M. E. (ed.) Int. Oceanogr. Congr. Preprints, AAAS, Washington, D. C. p. 850-851.

Riley, G. A. 1967. The plankton of estuaries. In Lauff, G. H. (ed.) Estuaries, p. 316-326, AAAS Publ. No. 83, Washington, D. C. 757 p.

Riley, G. A., and D. F. Bumpus. 1946. Phytoplankton-zooplankton relationships on Georges Bank. J. Mar. Res. 6(1): 33-47.

Riley, G. A. and S. M. Conover. 1956. Oceanography of Long Island Sound, 1952-1954. II. Chemical Oceanography. Bull. Bing. Oceanogr. Coll. 15: 47-61.

Riley, G. A. and S. M. Conover. 1967. Phytoplankton of Long Island Sound, 1954-1955. Bull. Bingham Oceanogr. Coll. 19(2): 5-34.

Riley, G. A. and S. Gorgy. 1948. Quantitative studies of summer plankton populations of the western North Atlantic. J. Mar. Res. 7(2): 100-121.

Riley, G. A., H. Stommel and D. Bumpus. 1949. Quantitative ecology of the plankton of the western North Atlantic. Bull. Bingham Oceanogr. Coll. 12(3): 1-169.

Ropes, J. W., J. L. Chamberlin and A. S. Merrill. 1969. Surf clam fishery, p. 119-126. In F. Firth (ed.) Encyclopedia of marine resources, Van Nostrand Reinhold Co., New York.

Rowe, G. T. 1971. Observations on bottom currents and epibenthic populations in Hatteras Submarine Canyon. Deep-Sea Res. 18: 569-581.

Rowe, G. T. and R. J. Menzies. 1969. Zonation of large benthic invertebrates in the deep sea off the Carolinas. Deep-Sea Res. 16: 531-537.

Ryther, J. H. 1954. The ecology of phytoplankton blooms in Moriches Bay and Great South Bay, Long Island, New York. Biol. Bull. 106: 198-209.

Ryther, J. H. and W. M. Dunstan. 1971. Nitrogen, phosphorus and eutrophication in the coastal marine environment. Sci. 171: 1008-13.

Ryther, J. H., C. S. Yentsch, E. M. Hulburt and R. F. Vaccaro. 1958. The dynamics of a diatom bloom. Biol. Bull. 115(2): 257-268.

Sage, L. E. and S. S. Herman. 1972. Zooplankton of the Sandy Hook Bay area, New Jersey. Ches. Sci. 13(1): 24-39.

Saila, S. B. and J. M. Flowers. 1969. Geographic morphometric variation in the American lobster. Systematic Zool. 18: 330-338.

Saila, S. B. and J. M. Flowers. 1968. Movements and behavior of berried female lobsters displaced from offshore areas to Narragansett Bay, Rhode Island. J. Du Conseil 31: 342-351.

Saila, S. B. and S. D. Pratt. 1973. Mid-Atlantic Bight fisheries, p. 6-1 to 6-125. In S. Saila (ed.) Coastal and offshore environmental inventory Cape Hatteras to Nantucket Shoals. U. Rhode Island, Kingston.

Saila, S. B., S. D. Pratt and T. Polgar. 1972. Dredge spoil disposal in Rhode Island Sound. Marine Tech. Rept. 2, U. Rhode Island. 48 p.

Salem County Planning Board. 1970. A plan for comprehensive development. Salem, New Jersey. 55 p.

Salisbury-Wicomico County (Maryland) Planning and Zoning Commission. 1971. Natural features and development patterns--Wicomico County: a comprehensive development plan background study. Salisbury, Maryland. 41 p.

Salwen, B. B. 1962. Sea levels and archaeology in the Long Island Sound area. American Antiquity. 28(1): 46-55.

Salwen, B. B. 1965. Sea levels and the Archaic archaeology of the northeast coast of the United States. Ph.D. dissertation. Columbia U., New York, N. Y. 257 p.

Sameoto, D. C. 1969. Comparative ecology, life histories and behavior of intertidal sand-burrowing amphipods (Crustacea: Haustoriidae) at Cape Cod. J. Fish. Res. Bd. Can. 26: 361-388.

Sanders, H. L. 1956. Oceanography of Long Island Sound. X. The biology of marine bottom communities. Bull. Bingham Oceanogr. Coll. 15: 345-414.

Sanders. H. L. 1958. Benthic studies in Buzzards Bay. I. Animal sediment relationships. Limnol. Oceanogr. 36: 245-258.

Sanders, H. L. 1973. Some biological effects related to the West Falmouth oil spill. In Background papers for a workshop on inputs, fates and effects of petroleum in the marine environment. Vol. 2. Prepared under the aegis of the Oceans Affairs Board, National Academy of Sciences, Washington, D. C.

Sanders, H. L., J. F. Grassle and G. R. Hampson. 1972. The West Falmouth oil spill. Part I. Biology. Woods Hole Oceanographic Institution Tech. Rep. No. WHOI-72-20. 49 p.

Sanders, H. L. and R. R. Hessler. 1969. Ecology of the deep-sea benthos. Sci. 163: 1419-1424.

Sanders, H. L., R. R. Hessler and G. R. Hampson. 1965. An introduction to the study of deep-sea benthic faunal assemblages along the Gay Head-Bermuda transect. Deep-Sea Res. 12: 845-867.

Sanders, H. L., J. F. Grassle and G. R. Hampson. 1972. The West Falmouth oil spill 1. Biology II. Woods Hole Ocean. Inst. Tech. Report, WHOI-72-20.

Sandy Hook Marine Laboratory. 1972. The effects of waste disposal in the New York Bight. Summary and final report. NTIS. AD 743936.

Sarnits, A. A. and J. I. Sauskan. 1967. Hydrological conditions and distribution of silver hake *Merluccius bilinearis* Mitchell on Georges Bank and off Nova Scotia in 1962-1964. Res. Bull. Int. Comm. N. W. Atlantic Fish. (4): 76-86.

Saunders, P. M. 1971. Anticyclonic eddies formed from shoreward meanders of the Gulf Stream. Deep-Sea Res. 18: 1207-1219.

Saville, A. 1965. Factors controlling dispersal of the pelagic stages of fish and their influence on survival. ICNAF Spec. Publ. 6: 335-348.

Scarratt, D. J. and V. Zitko. 1971. Bunker C oil in sediments and benthic animals from shallow depths and Chedabucto Bay, Nova Scotia. J. Res. Bd. Canada. 29: 1347-1350.

Saxon, W. 1973. The Paleo-Indian on Long Island, New York State Archaeol. Assoc. Bull. 57: 1-11.

Schlee, J. 1973. Atlantic continental shelf and slope of the United States-sediment texture of the northeastern part. USGS Prof. Pap. 529-L. U. S. Department of the Interior. Washington, D. C. 64 p., 6 pl.

Schlee, J., J. C. Behrendt, R. E. Mattuck and P. T. Taylor. 1975. Structure of the continental margin off mid-Atlantic states (Baltimore Canyon trough). USGS, Open File Report 75-60. U. S. Department of the Interior, Washington, D. C. 45 p.

Schlee, J. and R. M. Pratt. 1970. Atlantic continental shelf and slope of the United States--gravels of the northeastern part. USGS Prof. Pap. 529-H. U. S. Department of the Interior. Washington, D. C. 39 p., 5 pl.

Schroeder, E. 1966. Average surface temperatures of the western North Atlantic. Bull. Mar. Sci. 16: 302-323.

Schubel, J. R. 1969. Distribution and transport of suspended sediment in upper Chesapeake Bay. Ches. Bay Inst., Johns Hopkins University Tech Rept. 60, Ref. #69-13, 22 p.

Schubel, J. R. 1972. The physical and chemical conditions of Chesapeake Bay: an evaluation. Ches. Bay Inst. Special Rept. #72-1. 73 p.

Schurr, Sam H. (ed.). 1972. Energy economic growth and the environment. Johns Hopkins Press, Baltimore.

Schurr, Sam H. and Paul T. Homan. 1971. Middle Eastern oil and the western world. American Elsevier Publishing Company, New York.

Schwartz, M. L. 1973. Barrier Islands. Dowden, Hutchinson and Ross, Inc. Stroudsburg, Pennsylvania. 464 p.

Scott, A. 1970. Economic obstacles to marine development, p. 153-167. In W. J. McNeil (ed.) Marine agriculture. Oregon State University Press, Corvallis.

Seaber, P. R. 1963. Chloride concentrations of water from wells in the Atlantic coastal plain of New Jersey, 1923-1961. Spec. Rept. 22. New Jersey Department of Conservation and Economic Development, Trenton, New Jersey. 250 p.

Sears, M. and G. L. Clarke. 1940. Annual fluctuations in the abundance of marine zooplankton. Biol. Bull. 74: 321-328.

Shafrin, E. G. and W. A. Zisman. 1967. Critical surface tension for spreading on a liquid substrate. Naval Research Laboratory. Washington, D. C. NRL Rept. No. 6488. 16 p.

Shapiro, S. 1971. Our changing fisheries. U. S. Government Printing Office. p. 1-534.

Shaw, D. M. 1973. Physical Oceanography (Waves). In Coastal and offshore environmental inventory--Cape Hatteras to Nantucket shoals. Marine Publ. Series No. 2. U. Rhode Island. 1-61 to 1-66.

Shaw, W. N. and G. L. Griffith. 1967. Effects of polystream and drills on oyster setting in Chesapeake Bay and Chincoteaque Bay. Proc. Nat. Shellfish Ass. 57: 17-23.

Shepard, F. P. 1963. Submarine geology. Harper and Row, New York 557 p.

Shepard, F. P. and R. F. Dill. 1966. Submarine canyons and other sea valleys. Rand McNally, Chicago. 381 p.

Sheridan, R. E. 1974a. Conceptual model for the block-fault origin of the North American Atlantic continental margin geosyncline. Geology. 2(9): 465-468.

Sheridan, R. E. 1974b. Atlantic continental margin of North America. In C. A. Burk and C. L. Drake (eds.) Geology of continental margins. Springer-Verlag, New York. p. 391-407.

Sheridan, R. E. 1975. Preliminary report on geophysical study of dome structure--Atlantic outer continental shelf east of Delaware. Amer. Assoc. Petrol. Geol. 59(7): 1203-1211.

Sheridan, R. E. and H. J. Knebel. 1975. Evidence of youthful faulting on the outer continental shelf. Geol. Soc. America, Abstr. with Programs, Annual Mtg. 7(7): 1268.

Sherman, K., J. B. Colton, F. R. Knapp and R. L. Dryfoos. 1973. Fish larvae found in environment contaminated with oil and plastic. National Marine Fisheries Service, MARMAP Red Flag Rept. No. 1.

Sherman, K. and K. A. Honey. 1971. Size selectivity of the Gulf III and Bongo zooplankton samplers. Int. Comm. N. W. Atl. Fish. Res. Bd. No. 8: 45-48.

Shipton, J., J. H. Last, K. E. Murray and G. L. Vale. 1970. Studies on a kerosene-like taint in mullet (Mugil cephalus). J. of the Science of Food and Agric. 21: 433-436.

Shreve, F., M. A. Chrysler, F. H. Blodgett and F. W. Besley. 1910. The plant life of Maryland. Maryland Weather Service, Spec. Publ., Vol. III. The Johns Hopkins Press, Baltimore. 533 p.

Shuster, C. 1959. A biological evaluation of the Delaware River estuary. Inform. Ser. Publ. No. 3, U. Delaware Mar. Lab. p. 1-77.

Siple, G. E. 1946. Progress report on groundwater investigations in South Carolina. South Carolina Resources, Planning and Development Board Bull. 15. 166 p

Sivadier, H. D. and P. G. Mikoloj. 1973. Measurement of evaporation rates from oil slicks on the open sea. In Proceedings of the joint conference on prevention and control of oil pollution. Sponsored by EPA, API and USGS. p. 475-484.

Sivanton,J. R. 1952. The Indian tribes of North America. Smithsonian Institution, Bureau of American Ethnology, Bull. 145, Map 5.

Smayda, T. J. 1957. Phytoplankton studies in lower Narragansett Bay. Limnol. Oceanogr. 2 (4): 342-359.

Smayda, T. J. 1961. Some quantitative aspects of primary production in a Rhode Island coastal salt pond. First Nat. Coastal and Shallow Water Conf. p. 123-125.

Smayda, T. J. 1973. Phytoplankton. In Coastal and offshore environmental inventory--Cape Hatteras to Nantucket shoals. Marine Publ. Series No. 2. U. Rhode Island. 3-1 to 3-100.

Smith, C. L. and W. G. MacIntyre. 1971. Initial aging of fuel oil films on seawater. In Proceedings of the joint conference on prevention and control of oil spills. Sponsored by EPA, API and USGS. p. 457.

Smith, J. E. (ed.). 1968. *Torrey Canyon* pollution and marine life. Cambridge University Press. Cambridge, England. 196 p.

Smith, H. A. 1975. What is the geology of the west Sable structure. Oil and Gas J. June 2, 1975. p. 170-172.

Smith, W. G. 1973. The distribution of the summer flounder, *Paralichthys dentatus*, eggs and larvae on the continental shelf between Cape Cod and Cape Lookout. 1965-1966. U. S. Department of Commerce, NOAA Fish Bull., Vol. 71, No. 2: 257-548.

Snodgrass, R. E. 1952. The sand crab *Emerita talpoida* (Say) and some of its relatives. Smiths. Misc. Colls. 117. 34 p.

Snyder, N. W. 1974. Energy recovery and resource recycling. Chemical Engineering/ Deskbook issue. p. 65-72.

Soil Conservation Service. 1967. Soil classification, a comprehensive system, seventh approximation and supplement. U. S. Department of Agriculture, Washington, D. C.

Soil Conservation Service. 1970a. General soil map of the United States, Sheet 11. U. S. Department of Agriculture. Washington, D. C. Map and text (unpubl. document).

Soil Conservation Service. 1970b. General soil map of the United States, Sheet 6, U. S. Department of Agriculture. Washington, D. C. Map and text (unpubl. document).

Southeastern Virginia Planning District Commission. 1970. Regional data report #32-- land use element. Norfolk, Virginia. 7 p.

Southeastern Virginia Regional Planning Commission. 1969. Regional Data Report #28-- Regional land use-1965. Norfolk, Virginia. 9 p.

Sponner, M. F. 1971. Effects of oil and emulsifiers on marine life. *In* P. Hepple (ed.) Water pollution by oil: proceedings of a siminar held at Aviemore. Institute of Petroleum, London. p. 375-376.

St. Amant, L. S. 1970. Biological effects of petroleum exploration and production in coastal Louisiana. *In* Holmes and DeWitt (eds.) Santa Barbara Oil Symposium, Santa Barbara, December 16-18. U. California.

Stebbings, R. E. 1970. Recovery of salt marsh in Brittany sixteen months after heavy pollution by oil. Environ. Poll. 1: 163-167.

Steele, D. H. 1963. Pollock (*Pollachius virens*) in the Bay of Fundy. J. Fish. Res. Bd. Can. 20: 1267-1314.

Steimle, F. W., and R. B. Stone. 1973. Abundance and distribution of inshore benthic fauna off southwestern Long Island, New York. Tech. Rept. NMFS SSRF-673: 1-50.

Stewart, H. B. Jr. 1958. Upstream bottom currents in New York harbor. Science 127 (3306): 1113-1115.

Stewart, L. L. 1972. The seasonal movements, population dynamics and ecology of the lobster, *Homarus americanus* (Milne-Edwards), off Ram Island, Connecticut. Ph.D. Thesis, U. Connecticut.

Stewart, R. J. 1973. Dispersion predictions for offshore oil slicks and a Bayesian analysis of spill volume distributions. Unpubl. master's thesis, Department of Ocean Engineering, MIT, Cambridge, Massachusetts.

Stewart, R. J., J. W. Devanney III and W. Briggs. 1974. Oil spill trajectory studies for Atlantic coast and Gulf of Alaska. *In* Primary, physical impacts of offshore petroleum developments. Report No. MITSG 74-20, MIT, Cambridge, Massachusetts. 186 p.

Stewart, R. J. and J. W. Devanney III. 1974. Probabilistic trajectory assessments for offshore oil spills impacting Long Island. Report to Regional Marine Resources Council Nassau-Suffolk Planning Board. 34 p.

Stickney, A. P. 1967. Orientation of juvenile Atlantic herring (Clupea harengus harengus L.) to temperature and salinity p. 323-342. In Proceedings of the FAO Conference on fish behavior in relation to fish techniques and tactics. FAO Fish Report No. 62, Vol. 2.

Stickney, A. P. and D. Stringer. 1957. A study of the invertebrate bottom fauna of Greenwich Bay, Rhode Island. Ecol. 38: 111-122.

Stone, R. B. 1963. A quantitative study of benthic fauna in lower Chesapeake Bay with emphasis on animal-sediment relationships. M. S. Thesis, School Mar. Sci., Coll. William and Mary.

Strand, J. A., W. L. Templeton, J. A. Lichatourch and C. W. Apts. 1971. In Proceedings of joint conference on prevention and control of oil spills, Washington, D. C. American Petroleum Inst., New York. p. 279-286.

Straughan, D. 1972. The influence of the Santa Barbara oil spill (January-February, 1969) on the intertidal distribution of marine organisms. Rept. to Western Oil Gas Assoc. 59 p.

Stubblefield, W. L., J. W. Lavelle, D. J. P. Swift and T. F. McKinney. 1975. Sediment response to the present hydraulic regime on the central New Jersey shelf. J. Sed. Petrol. 45(1): 337-358.

Sverdrup, H. U., M. W. Johnson and R. H. Fleming. 1942. The oceans--their physics, chemistry and general biology. Prentice-Hall, Inc. Englewood Cliffs, New Jersey. 1087 p.

Swift, D. J. P. In press. Continental shelf sedimentation. In Fairbridge (ed.) Encyclopedia of Sedimentology. Reinhold, New York

Swift, D. J. P., D. B. Duane and T. F. McKinney. 1973. Ridge and swale topography of the middle Atlantic Bight, North America: secular response to the Holocene hydraulic regime. Marine Geology. 15: 227-247.

Swift, D. J. P., J. W. Kofoed, F. P. Saulsbury and P. Sears. 1972. Holocene evolution of the shelf surface, central and southern Atlantic shelf of North America. In D. J. P. Swift, D. B. Duane and O. H. Pilkey (eds.) Shelf sediment transport. Dowden, Hutchinson, and Ross, Inc. Stroudsburg, Pennsylvania. p. 499-574.

Swift, D. J. P. and P. Sears. 1974. Estuarine and littoral patterns in the surficial sand sheet, central and southern Atlantic shelf of North America. In G. P. Allen (ed.) Shelf and estuarial sedimentation: a symposium. U. Bordeaux, Institut de Geologie du Bassin d'Aquitaine, Talence, France. p. 171-189.

Tarrant, Julian. 1965. For Queen Anne's County (Maryland) Planning and Zoning Commission. Centreville, Maryland. 74 p.

Tarrant, Julian. 1965. For Worcester (Maryland) County Planning and Zoning Commission. Comprehensive Master Plan, Worcester County, Maryland. Snow Hill, Maryland. 155 p.

Task Force of the Harbor Planning Process Advisory Committee. 1974. Baltimore Harbor Plan. Baltimore, Maryland. 102 p., 209 suppl.

Taylor, P. T., I. Ziety and L. S. Dennis. 1968. Geologic implications of aeromagnetic data for the eastern continental margin of the United States. Geophysics. 33(5): 758-821.

Tendron, G. 1969. Contamination of marine flora and fauna by oil and the biological consequences of the "Torrey Canyon" accident. Proceedings of the International Conference on Oil Pollution of the Sea, Rome. p. 114-121.

Thom, H. C. 1971. Asymptotic extreme-valve distributions of wave heights in the open ocean. J. Mar. Res. 29: 19-27.

Thomas, M. L. H. 1973. Effects of Bunker C oil on intertidal and lagoonal biota in Chedabucto Bay, Nova Scotia. J. of the Fish. Res. Bd. Can. 30: 83-90.

Thomas, R. A. 1974. A brief survey of prehistoric man on the Delmarva Peninsula. Delaware Archaeological Survey, Dover, Delaware. 17 p.

Thomas, R. A. and N. H. Warren. 1970. A Middle Woodland cemetery in central Delaware: excavations at the Island Field site. Archaeol. Soc. of Delaware Bull. #8, new series. 33 p.

Thornbury, W. D. 1965. Regional geomorphology of the United States. John Wiley and Sons, New York. 609 p.

Tibbo, S. N., J. E. Henri Legere, L. W. Scatterwood and R. F. Temple. 1958. On the occurrence and distribution of larval herring (Clupea harengus L.) in the Bay of Fundy and the Gulf of Maine. J. Fish. Res. Bd. Can. Vol. 15, No. 6. p. 1451-1469.

Todd, T. H., et al. 1972. An introduction to environmental ethology. WHOI-72-43. Unpub. manuscript. Woods Hole, Woods Hole Oceanographic Institute.

Trask, T. 1971. A study of the three sandy beaches in the Santa Barbara, California, area. In D. Straughan (ed.) Biological and oceanographic survey of the Santa Barbara Channel oil spill, 1969-1970. Allan Hancock Foundation, U. Southern California, Los Angeles.

Travel Economic Impact Model: Economic Analysis Methodology (draft). August 1975. U. S. Travel Data Center (under contract to BLM, U. S. DOI), Washington, D. C.

Travel Industry Council on Energy Conservation Report: the importance of tourism to the U. S. economy--1975. U. S. Travel Data Center, Washington, D. C.

Tressler, W. L. and R. Bere. 1939. A quantitative study of the plankton of the Bays of Long Island. In A biological survey of the salt waters of Long Island, 1938. Part I. Rept. N.Y. St. Conserv. Dep. (14): 177-191.

TRIGOM (Research Institute of the Gulf of Maine). 1974. A socio-economic and environmental inventory of the North Atlantic region. South Portland, Maine.

Trumbull, J. V. A. 1972. Atlantic continental shelf and slope of the United States--sand size fraction of bottom sediments, New Jersey to Nova Scotia. USGS Prof. Pap. 529-K. U. S. Department of the Interior, Washington, D. C. 45 p.

Trybulski. S. 1975. For bathers in Rockaway, "twas whale of a relief from 'sharks.'" Long Island Press, Jamaica, New York.

Tuck, L. M. 1960. The murres. Dept. Northern Affairs and Natl. Res. Natl. Parks Br., Can. Wildl. Serv. Ser. 1. 260 p.

Tyler, A. V. 1972. Food resource division among northern marine demersal fishes. J. Fish. Res. Bd. Can. 29(7): 997-1003.

Uchupi, E. 1963. Sediments on the continental margin off eastern United States. USGS Survey Prof. Pap. 475-C: C132-137.

Uchupi, E. 1968. Atlantic continental shelf and slope of the United States--physiography. USGS Prof. Pap. 529-C. U. S. Department of the Interior, Washington, D. C. 30 p.

Uchupi, E. 1970. Atlantic continental shelf and slope of the United States--shallow structure. USGS Prof. Pap. 529-I. U. S. Department of the Interior, Washington, D. C. 44 p., 1 pl.

Urban Pathfiners, Inc. 1973. Background studies: Talbot County, Maryland Comprehensive Planning Program. Easton, Maryland. 150 p.

U. S. Army Corps of Engineers. 1950. Waterborne commerce of the United States. Calendar year 1950. Vicksburg, Mississippi. 1767 p.

U. S. Army Corps of Engineers. 1955. Waterborne commerce of the United States. Calendar year 1955, Part 1. Waterways and harbors, Atlantic Coast. Vicksburg, Mississippi. 388 p.

U. S. Army Corps of Engineers. 1960. Waterborne commerce of the United States. Calendar year 1960, Part 1. Waterways and harbors, Atlantic Coast. Vicksburg, Mississippi. 380 p.

U. S. Army Corps of Engineers. 1965. Waterborne commerce of the United States. Calendar year 1965, Part 1. Waterways and harbors, Atlantic Coast. Vicksburg, Mississippi. 285 p.

U. S. Army Corps of Engineers. 1971. National shoreline study, North Atlantic region. North Atlantic Corps of Engineers, New York. 2 Volumes.

U. S. Army Corps of Engineers. 1970. Waterborne commerce of the United States. Calendar year 1970, Part 1. Waterways and harbors, Atlantic Coast. Vicksburg, Mississippi. 257 p.

U. S. Army Corps of Engineers (North Atlantic Division). 1972. Appendix C. Climate, meteorology and hydrology. In North Atlantic Regional Water Resources Study. 245 p.

U. S. Army Corps of Engineers. 1973. Waterborne commerce of the United States. Calendar year 1973, Part 1. Waterways and harbors, Atlantic Coast, Vicksburg, Mississippi. 210 p.

U. S. Bureau of the Census. 1972. Census of Housing: 1970. Vol. 1. Housing characteristics for states, cities and counties, Part 9. Delaware.

U. S. Bureau of the Census. 1972. Census of Housing: 1970. Vol. 1. Housing characteristics for states, cities and counties, Part 22. Maryland.

U. S. Bureau of the Census. 1972. Census of Housing: 1970. Vol. 1. Housing characteristics for states, cities and counties, Part 32. New Jersey.

U. S. Bureau of the Census. 1972. Census of Housing: 1970. Vol. 1. Housing characteristics for states, cities and counties, Part 34. New York.

U. S. Bureau of the Census. 1972. Census of Housing: 1970. Vol. 1. Housing characteristics for states, cities and counties, Part 40. Pennsylvania.

U. S. Bureau of the Census. 1972. Census of Housing: 1970. Vol. 1. Housing characteristics for states, cities and counties, Part 48. Virginia.

U. S. Bureau of the Census. 1963. Census of Population: 1960. Vol. 1. Characteristics of the population, Part 9. Delaware. Washington, D. C.

U. S. Bureau of the Census. 1963. Census of Population: 1960. Vol. 1. Characteristics of the population, Part 19. Maryland. Washington, D. C.

U. S. Bureau of the Census. 1963. Census of Population: 1960. Vol. 1. Characteristics of the population, Part 32. New Jersey. Washington, D. C.

U. S. Bureau of the Census. 1963. Census of Population: 1960. Vol. 1. Characteristics of the population, Part 34. New York. Washington, D. C.

U. S. Bureau of the Census. 1963. Census of Population: 1960. Vol. 1. Characteristics of the population, Part 40. Pennsylvania. Washington, D. C.

U. S. Bureau of the Census. 1963. Census of Population: 1960. Vol. 1. Characteristics of the population, Part 48. Virginia. Washington, D. C.

U. S. Bureau of the Census. 1973. Census of Population: 1970. Vol. 1. Characteristics of the population, Part 1. United States summary--Section 1. Washington, D. C.

U. S. Bureau of the Census. 1973. Census of Population: 1970. Vol. 1. Characteristics of the population, Part 9. Delaware. Washington, D. C.

U. S. Bureau of the Census. 1973. Census of Population: 1970. Vol. 1. Characteristics of the population, Part 19. Maryland. Washington, D. C.

U. S. Bureau of the Census. 1973. Census of Population: 1970. Vol. 1. Characteristics of the population, Part 32, New Jersey--Section 1. Washington, D. C.

U. S. Bureau of the Census. 1973. Census of Population: 1970. Vol. 1. Characteristics of the population, Part 34. New York--Section 1. Washington, D. C.

U. S. Bureau of the Census. 1973. Census of Population: 1970. Vol. 1. Characteristics of the population, Part 40. Pennsylvania--Section 1. Washington, D. C.

U. S. Bureau of the Census. County and city data book, 1972. U. S. Government Printing Office, Washington, D. C. 1973.

U. S. Bureau of Land Management. 1974. Final environmental statement, proposed 1974 outer continental shelf oil and gas general lease sale offshore Louisiana. U. S. Department of the Interior. Washington, D. C. 3 Vols. 1148 p.

U. S. Bureau of Mines. 1973. Independent Petroleum Association of America. Summary of statistics, supply and demand outlook. December 1973.

U. S. Department of Commerce. 1963. Selective guide to published climatic data sources. Prepared by the U. S. Weather Bureau. 84 p.

U. S. Department of Commerce. 1968. Climatic atlas of the United States. 80 p.

U. S. Department of Commerce. 1973. Earthquake history of the United States. J. L. Coffman and C. A. von Hake (eds.) U. S. Government Printing Office, Washington, D. C. 208 p.

U. S. Department of Commerce. NOAA National Ocean Survey. 1971. Tidal current tables, 1972, Atlantic coast of North America. 200 p.

U. S. Department of Commerce. NOAA National Ocean Survey. 1974. United States Coast Pilot 3, Atlantic Coast, Sandy Hook to Cape Henry. 215 p.

U. S. Department of Commerce. NOAA National Ocean Survey. 1975. United States Coast Pilot 2, Atlantic Coast, Cape Cod to Sandy Hook. 257 p.

U. S. Department of the Interior. Geological Survey. 1974. Accidents connected with federal oil and gas operations in the outer continental shelf, Gulf of Mexico. Unpub.

U. S. Department of the Interior. 1974. Fish and Wildlife Resource Reports for the middle Atlantic region.

U. S. Department of Transportation. Coast Guard. 1971. Polluting spills in U. S. waters--1970. Washington, D. C. 13 p.

U. S. Department of Transportation. Coast Guard. 1972. Polluting incidents in and around U. S. waters, Calendar year 1971. Washington, D. C. 11 p.

U, S. Department of Transportation. Coast Guard. 1973. Polluting incidents in and around U. S. waters, Calendar year 1972. Washington, D. C. 11 p.

U. S. Department of Transportation. Coast Guard. 1974. Polluting incidents in and around U. S. waters, Calendar year 1973. Washington, D. C. 11 p.

U. S. Department of Transportation. Coast Guard. 1975. Polluting incidents in and around U. S waters, Calendar year 1974. Unpub.

U. S. Department of Transportation. 1946. War action casualties involving merchant tank vessels. U. S. Coast Guard Report CG-173. Washington, D. C. 174 p.

U. S. F. W. P. C. A. 1967. Proceedings conference pollution of the navigable waters of Moriches Bay and the eastern section of Great South Bay and their tributaries, June 21, 1967. U. S. Government Printing Office, 957-639. 134 p.

U. S. Federal Energy Administration. 1974. Project independence report, Washington, D. C. U. S. Government Printing Office.

U. S. Federal Power Commission. 1974. Opinion and order prescribing uniform national rate for sales of natural gas, opinion no. 699. U. S. Government Printing Office, Washington, D. C.

U. S. Fish and Wildlife Service. 1974. United States list of endangered fauna. U. S. Department of the Interior, Washington, D. C. 22 p.

U. S. Geological Survey. 1975. OCS statistics, Calendar year 1974. Washington, D. C.

U. S. Geological Survey, 1975. Sediments, structural framework, petroleum potential, environmental conditions and operational considerations of the mid-Atlantic area. Open File Report #75-61. U. S. Department of the Interior, Washington, D. C. 143 p.

U. S. Naval Weather Service. 1970. Summary of synoptic meteorological observations, North American coastal marine areas, Vol. II. Area 4--Boston, Area 5--Quonset Point, Area 6--New York, Area 7--Atlantic City. Naval Weather Service Environmental Detachment. Asheville, North Carolina. 632 p.

U. S. Naval Weather Service Command. 1970a. Summary of synoptic meteorological observations: North American coastal marine areas 2. 632 p.

U. S. Naval Weather Service Command. 1970b. Summary of synoptic meteorological observations: North American coastal marine areas 3. 474 p.

Uspenskii, S. M. 1964. Present day problems of nature conservation in the Arctic. Problems of the North. 7: 171-178.

Vale, G. H., G. S. Sidhu, W. A. Montgomery and A. R. Johnson. 1970. Studies of a kerosene-like taint in mullet (Mugil cephalus). J. of the Science of Food and Agri. 21: 433-436.

Van Dorn, W. 1953. Wind stress on an artificial pond. J. Mar. Res. 12: 249-271.

Veatch, A. C. and P. A. Smith. 1939. Atlantic submarine valleys of the United States and the Congo Submarine Valley. Geol. Soc. Amer. Spec. Pap. 7. 101 p.

Virginia Commission on Outdoor Recreation. 1974. Virginia Outdoors Plan, Richmond, Virginia. 175 p.

Virginia State Air Pollution Control Board. 1974. Ambient air quality data annual report. 98 p.

Vladykov, V. D. and D. H. Wallace. 1938. Is the striped bass of the Chesapeake Bay a migratory fish? Trans. Amer. Fish Soc. 67: 67-86.

Vokes, H. E. and J. Edwards, Jr. 1957. Geography and geology of Maryland. Maryland Geological Survey, Bull. 19. Baltimore, Maryland. 242 p.

Volkmann, G. 1962. Deep current observations in the western North Atlantic. Deep-Sea Res. 9: 493-500.

Walford, L. A. and R. I. Wicklund. 1968. Monthly sea temperature structure from the Florida Keys to Cape Cod. Am. Geogr. Soc. Serial Atlas of the Marine Environment Folio 15. 2 p. 16 PL APP.

Wallace, D. H. and W. C. Neville. 1942. The problem of conservation of striped bass on the Atlantic Coast. Ches. Biol. Lab., Solomons, Maryland.

Wang, S. and L-S. Hwang. 1974. A numerical model for simulation of oil spreading and transport and its application for predicting oil slick movement in bays. Tetra Tech Report TT-P-345-74-1. Tetra Tech, Inc. Pasadena, California. 103 p.

Warburton, F. E. 1958. The effects of boring sponges on oysters. Progr. Rep. Atl. Biol. Sta. 68: 3-8.

Warren, D. H. 1968. Transcontinental geophysical survey (35^0-39^0N) seismic refraction profiles of the crust and upper mantle. USGS Misc. Geol. Invest. Map I-535-D. U. S. Department of the Interior. Washington, D. C.

Warsh, C. E. 1974. Physical oceanography of deep water dumpsite 106 (No. 227). Unpub. 122 p.

Wass, M. L. 1965. Checklist of the marine invertebrates of Virginia. Va. Inst. Mar. Sci. Spec. Sci. Rept. 24 (revised). 55 p.

Wass, M. L. 1967. Biological and physiological basis of indicator organisms and communities. In Osbon, T. A. and F. J. Burgess (ed.) Pollution and marine ecology. Interscience, New York. p. 271-283.

Water Fowl Harvest and Hunter Activity in the U. S. During the 1971 Hunting Season. 1972. Division of Wildlife Research, Bureau of Sport Fisheries and Wildlife, U. S. Department of the Interior. Laurel, Maryland.

Waterfowl Harvest and Hunter Activity in the U. S. During the 1972 Hunting Season. 1973. Office of Migratory Bird Management, Bureau of Sport Fisheries and Wildlife, U. S. Department of the Interior, Laurel, Maryland.

Waterfowl Harvest and Hunter Activity in the U. S. During the 1973 Hunting Season. 1974. Office of Migratory Bird Management, Fish and Wildlife Service, U. S. Department of the Interior. Laurel, Maryland.

Waterfowl Harvest and Hunter Activity in the U. S. During the 1974 Hunting Season. 1975. Office of Migratory Bird Management, Fish and Wildlife Service, U. S. Department of the Interior. Laurel, Maryland.

Waters, J. H. and C. J. Rivard. 1962. Terrestrial and marine mammals of Massachusetts and other New England states. Standard Modern Printing Co., Brockton, Massachusetts. 151 p.

Watling, L. and D. Maurer. 1972. Marine shallow water amphipods of the Delaware Bay area. U. S. A. Crustaceana. Suppl. 3: 251-266.

Watling, L. and D. Maurer. 1974. An evaluation of the mid-Atlantic Bight inner continental shelf benthic assemblages. *In* Marine environmental implications of offshore oil and gas development in the Baltimore Canyon region of the mid-Atlantic coast. Center of Adult Education, U. Maryland, College Park.

Weaver, L. K., H. F. Pierce and C. J. Jink. 1972. Offshore petroleum studies, U. S. Department of the Interior, Bureau of Mines, Washington, D. C., U. S. Government Printing Office.

Webster, F. 1969. Vertical profiles of horizontal ocean currents. Deep-Sea Res. 16: 85-98.

Weed, E. G. A., J. P. Minard, W. J. Perry, Jr., E. C. Rhodshamel and E. I. Robbins. 1974. Generalized pre-Pleistocene geologic map of the northern United States Atlantic continental margin. USGS Misc. Invest. Map I-861. Washington, D. C.

Wegner, F. 1975. Big waves fought to refloat little whale. Long Island Press, Jamaica, New York.

Weigle, J. M. 1974. Availability of fresh ground water in northeastern Worcester County, Maryland: with special emphasis on the Ocean City area. Maryland Geological Survey, Report of Investigations #24. Baltimore, Maryland. 64 p.

Welch, C. S. 1974. Geostrophic currents and Gulf Stream study for the outer continental shelf area of the Atlantic Ocean from Sandy Hook, New Jersey, to Cape Canaveral, Florida. Virginia Institute of Marine Science. Gloucester Point, Virginia.

Wells, H. W. 1957. Abundance of the hard clam *Mercenaria mercenaria* in relation to environmental factors. Ecol. 38: 123-128.

Whaley, R. C., J. H. Carpenter, R. L. Baker. 1966. Nutrient data summary 1964, 1965, 1966: Upper Chesapeake Bay (Smith Point to Turkey Point), Potomac, South, Severn, Magothy, Back, Chester, and Miles Rivers; and Eastern Bay. Ches. Bay. Inst., the Johns Hopkins University Spec. Report 12, Ref. #66-4, November.

Wheatland, S. B. 1956. Oceanography of Long Island Sound, 1952-1954. VII. Pelagic fish eggs and larvae. Bull. Bingh. Oceanogr. Coll. 15: 234-314.

Wheeler, W. M. 1899. The free-swimming copepods of the Woods Hole region. Bull. U. S. Fish Comm. 19: 157-192.

Whittle, K. J. and M. Blumer. 1970. Interactions between organisms and dissolved organic substances in the sea. Chemical attraction of the starfish *Asterias vulgaris* to oysters. *In* Hood (ed.) Symposium on organic matter in natural waters. U. Alaska Press, College. p. 495-507.

Wigley, R. L. 1965. Density dependent food relationships with reference to New England groundfish. ICNAF Spec. Publ. 6: 501-514.

Wigley, R. L. 1968. Benthic invertebrates of the New England fishing banks. Underwater Naturalist. 5: 8-13.

Wigley, R. L. and A. D. McIntyre. 1964. Some quantitative comparisons of offshore meiobenthos and macrobenthos south of Martha's Vineyard. Limnol. Oceanogr. 9: 485-493.

Wigley, R. L. and R. B. Theroux. 1965. Seasonal food habits of Highlands ground haddock. Trans. Am. Fish. Soc. 94(3): 243-251.

Wigley, R. L. and R. B. Theroux. 1970. Sea bottom photographs and macrobenthos collections from the continental shelf off Massachusetts. U. S. Fish and Wildlife Ser. Sci. Rep. Fisheries, No. 613. 14 p.

Williams, A. B. 1965. Marine decapod crustaceans of the Carolinas. U. S. Fish and Wildlife Serv. Fish. Bull. 65: 140.

Williams, S. J. 1975. Shallow subbottom structure and sediments of the Atlantic inner continental shelf off Long Island, New York. U. S. Army Corps of Engineers Coastal Engineering Research Center, Fort Belvoir, Virginia. Unpub. manuscript.

Williams, S. J. and D. B. Duane. 1974. Geomorphology and sediments of the inner New York Bight continental shelf. U. S. Army Corps of Engineers Coastal Engineering Research Center, Technical Memorandum No. 45, Fort Belvoir, Virginia. 83 p.

Wilson, N. D. and W. Abel. 1973. Seafloor scour protection for a semi-submersible drilling rig on the Nova Scotia shelf. Offshore Technology Conf. Preprints 2: 631-646.

Wintz, J. and K. F. Fauchald. 1971. Notes on some ophiuroids from the shelf off Santa Barbara. In D. Straughan (ed.) Biological and oceanographic survey of the Santa Barbara Channel oil spill, 1969-1970. Allan Hancock Foundation. U. Southern California, Los Angeles.

Wood, R. D. and J. Lutes. 1967. Guide to the phytoplankton of Narragansett Bay, Rhode Island. U. Rhode Island. 65 p.

Woolar, G. P., W. E. Bonini and R. P. Meyer. 1957. A seismic refraction study of the subsurface geology of the Atlantic coastal plain and continental shelf between Virginia and Florida. Wisconsin U., Department of Geology, Geophysics Sec. 128 p.

Worzel, J. L. 1965. Pendulum gravity measurements at sea 1939-1959. John Wiley and Sons, New York. 422 p.

Worzel, J. L. and G. L. Shurbert. 1955. Gravity anomalies at continental margins. National Academy of Sciences Proc. 41: 458-469.

Wu, J. 1968. Laboratory studies of wind-wave interaction. J. Fluid Mechanics. 34: 91-111.

Wulff, B. L., E. M. Wulff, B. H. Robison, J. K. Lowry and H. J. Humm. 1968. Summer marine algae of the jetty at Ocean City, Maryland. Chesapeake Sci. 9(1): 56-60.

Yancy, R. M. 1968. The 1967 Atlantic Coast surf clam fishery. Comm. Fish. Rev. 30(11): 40-46.

Yancy, R. M. and W. R. Welch. 1968. The Atlantic Coast surf clam--with a partial bibliography. U. S. Fish. Wildl. Serv. Cir. 288. 14 p.

Yamazi, J. 1966. Zooplankton communities of the Navesink and Shrewsbury Rivers and Sandy Hook Bay, New Jersey. Bur. Sport Fish. Wildl. Tech. Pap. 2: 1-44.

Zaneveld, J. S. 1966a. The marine algae of the American coast between Cape May, New Jersey and Cape Hatteras, North Carolina. I. The Cyanophyta. Bot. Mar. 9: 101-128.

Zaneveld, J. S. 1966b. The benthic marine algae of Delaware. A preliminary check list. Scientific Series, Publ. No. 2. Institute of Oceanography, Old Dominion College, Norfolk, Virginia. 35 p.

Zaneveld, J. S. and W. D. Barnes. 1965. Reproductive periodicities of some benthic algae in lower Chesapeake Bay. Chesapeake Sci. 6: 17-32.

Zobell, C. E. 1950. Assimilation of hydrocarbons by microorganisms. Advances in Enzymology. Vol. 10. p. 443-486.

Zobell, C. E. 1964. The occurrence, effects and fate of oil polluting the sea. In Proceedings of International Conference on water pollution research. Pergamon Press. London. p. 85-118.

ADDENDUM

TO

BIBLIOGRAPHY

Anderson, R.R. 1970. Submerged vegetation of Chincoteague Bay. Assateague Ecological Studies. Natural Resources Institute, U. Maryland. Final report, Pt. 1, Environmental Information.

Anderson, R.R. 1972. Submerged vascular plants of the Chesapeake Bay and tributaries. In A.J. McErlean (ed.) Biota of the Chesapeake Bay. Vol. 13, Supp.

Anonymous. 1968. Tidal current charts, upper Chesapeake Bay. U.S. Dept. of Commerce, NOAA. National Ocean Survey, 1p, 12CH.

Blandin, W.W. 1976. Results of the 1976 mid-winter waterfowl survey in the Atlantic flyway states. Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Washington, D.C.

Boesch, D.F. 1971. Distribution and structure of benthic communities in a gradient estuary. Ph.D. thesis. College of William and Mary, Virginia. 1-119.

Boesch, D.F. 1976. Benthic studies. *In* Second Quarterly Summary Report. Virginia Institute of Marine Science.

Boynton, W. 1970. Phytoplanktonic primary production in Chincoteague Bay. Assateague Ecological Studies. Natural Resources Institute, U. Maryland. Final report, Pt. 1, Environmental Information.

Cape May County Planning Board. The resort economy of Cape May County, New Jersey. Revised draft, 1975.

Chao, Y-Y. 1970. The theory of wave refraction in shoaling water, including the effects of caustics and the spherical earth. Geophys. Sci. Lab. TR-70-7, Dept. Meteorol. and Oceanogr., New York University, New York.

Chao, Y-Y, and W.J. Pierson, Jr. 1970. An experimental study of gravity wave behavior near a straight caustic. Geophys. Sci. Lab. TR-70-17, Dept. Meteorol. and Oceanogr., New York University, New York.

Cotton, A.D. 1933. Response to letter of F.M. Duncan. Nature. 132(3334):483.

Crocker, A.D., J. Cronshaw and W.N. Homes. 1974. The effect of crude oil on intertidal intestinal absorption in ducklings (*Anas platyrhychos*). Env. Pollution, 7:165-177.

Cronin, W.B. 1971. Volumetric, area, and tidal statistics of the Chesapeake Bay estuary and its tributaries. Chesapeake Bay Inst. Ref. 71-2. 135 p.

Daiber, F.C. 1971. Tide marsh ecology and wildlife. 1970-1971 Annual Pittman Robertson Report to the Division of Fish and Wildlife, State of Delaware, Dept. of Natural Resources and Env. Control. Proj. No. W 22 R 6.

Dawes, George. 1976. Personal communication. Wetlands Research Section, Virginia Institute of Marine Science, Gloucester Point, Virginia.

DeLong, R.L., W.G. Gilmartin and J.G. Simpson. 1973. Premature births in California sea lions: association with high organchloride pollutant residue levels. Science. 181: 1168-1170.

Duncan, F.M. 1933. Disappearance of *Zostera marina*. Nature. 132(3334):483.

Environmental Protection Agency. 1975c. Environmental aspects of chemical use in well drilling operations--conference proceedings. EPA Office of Toxic Substances, Washington, D.C. 604 p.

Environmental Protection Agency. 1976. Draft environmental impact statement on the ocean dumping of sewage sludge in the New York Bight. New York, N.Y. 341 p.

Feder, J. 1975. Prospects are for bad weather in the North Sea. Offshore 35(2): 98-100.

Florence, Benjamen. 1976. Unpub. Tag returns from 1370 large striped bass tagged in two Maryland spawning rivers. State of Maryland Fisheries Administration, Annapolis, Maryland.

Godske, C.L. 1957. Dynamic meteorology and weather forecasting. American Meteorol. Society, Boston, Massachusetts. 800 p.

Goldsmith, V. 1976. Baltimore canyon trough wave model. In Second quarterly summary report, environmental data acquisition and analysis--Mid-Atlantic OCS. Virginia Institute of Marine Science, Gloucester Point, Virginia. p. 36-48 and 58-61, 61 figures.

Grant, George. 1976. Zooplankton and neuston. In Second quarterly summary report. Virginia Institute of Marine Science.

Grantham, C.K., and J.P. Sloan. 1975. Toxicity study of drilling fluid chemicals on aquatic life. In Environmental aspects of chemical use in well-drilling operations. Houston, Texas. p. 103-110.

Gusey, W.F. 1976. The fish and wildlife resources of the middle Atlantic bight. Environmental Affairs, Shell Oil Company, Houston, Texas.

Haight, F.J., R.E. Finnegan, and G.L. Anderson. 1930. Tides and currents in Chesapeake Bay and tributaries. Spec. Publ. U.S. Coast, Geological Survey. (162) 143 p.

Hair, M.E. and S. Buckner. 1973. An assessment of the water quality characteristics of Great South Bay and contiguous streams. Garden City, New York. 59 p.

Halasi-Kun, G.J., and K. Widmer (eds.). 1975. Proceedings of university seminar on pollution and water resources (selected papers on special problems in ocean engineering), V. 7:1972-1973. New Jersey Bur. Geology and Topography Bull. 75-A. 147 p.

Halasi-Kun, G.J., and K. Widmer (eds.). 1975. Proceedings of university seminar on pollution and water resources (selected papers on special problems in ocean engineering), V. 8:1974-1975. New Jersey Bur. Geology and Topography Bull. 75-B. 173 p.

Heinle, D.A. 1972. Free-living copepods of the Chesapeake Bay. In A.J. McErlean (ed.) Biota of the Chesapeake Bay. Vol. 13, Supp.

Higgens, E.A., R.D. Rappleye and R.G. Brown. 1971. The flora and ecology of Assateague Island. U. Maryland. Agri. Exp. Sta., College Park, Maryland Bull. A-172.

Higman, D. 1972. Emergent vascular plants of the Chesapeake Bay wetlands. In A.J. McErlean (ed.) Biota of the Chesapeake Bay, Chesapeake Sci. Vol. 13, Supp.

Hollengsworth, J.W. and R. A. Lockhart. 1975. Fish toxicity of dispersed clay drilling mud deflocculants. In Environmental aspects of chemical use in well-drilling operations. May 1975. Houston, Texas. p. 113-123.

Idriss, I.,R. Dobry, and M. Power. 1976. Soil response considerations in seismic design of offshore platforms. J. Petroleum Tech. 28:244-252.

International Commission on Northwest Atlantic Fisheries. 1974. The statistical bulletin for 1974. ICNAF. Dartmouth, Canada.

Johnson, R.E., J.B. Lawrence, and J.C. Barlow, et al. 1974. Mapping survey of the marine wetlands of the Rudee and Lynhaven areas of Virginia Beach, Virginia. Institute of Oceanogr., Old Dominion University, Norfolk, Virginia.

Keefe, C. 1970. Primary production of Assateague Bay salt marshes. Assateague Ecological Studies. Natural Resources Institute, U. Maryland. Final report, Pt. 1, Environmental Information.

Keefe, C.W. 1972. Marsh production: a summary of the literature. Contrib. No. 483, Nat. Res. Inst. U. Maryland. Contri. in Mar. Sci. Vol. 16, 1972.

Keefe, C.W. and W.R. Boynton. 1973. Standing crop of salt marshes surrounding Chincoteague Bay, Maryland-Virginia. Chesa. Sci. Vol. 14, No. 2. p. 117-123.

Kennedy, J.L. 1974. Last winter underlined role of weather in North Sea work. Oil and Gas J. 72(22): 200-202.

Kiernan, L.A. 1976. Extent of oil spill surprised investigators. Washington Post. February 21, 1976.

Krauss, R.W. and P. Orris. 1972. Benthic macroalgae of the Maryland portion of the Chesapeake Bay. In A.J. McErlean (ed.) Biota of the Chesapeake Bay, Chesa. Sci. Vol. 13, Supp.

Lear, D.W. and G.G. Pesch. 1975. Effects of ocean disposal activities on the mid-continental shelf environment off Delaware and Maryland. EPA, Region III. Philadelphia, Pennsylvania. 175 p.

Lesser, F. 1965. Some environmental considerations of impounded tidal marshes on mosquito and waterbird prevalence. Little Creek Wildlife Area, Delaware. Master's thesis, U. Delaware.

Likens, E.E. and F. Herbert Bormann. 1974. Acid rain: a serious regional environmental problem. Science. Vol. 184, 1176-1179.

Lippson, A.J. (ed.). 1973. The Chesapeake Bay in Maryland: an atlas of natural resources. Natural Resources Institute of U. Maryland, Johns Hopkins University Press. Baltimore, Maryland.

Lissauer, I.M., and J.C. Bacon. 1975. Predicted oil slick movement from various locations off the New Jersey-Delaware coast line. U.S. Coast Guard Report CG-O-137-75. U.S. Dept. of Transportation, Washington, D.C. 126 p.

Malone, T.C. 1971. The relative importance of phytoplankton and netplankton as primary producers in tropical oceanic and neritic plankton communities. Limnol. Oceanogr. 16(4):633-639.

Mann, H. 1964. Effects on the flavour of fishes by oils and phenols. Symp. Pollut. Mar. Micro-Org. Prod. Petrol. Monaco. 1964. 371-374.

Martin, A.C., H. S. Zin and A. Nelson. 1961. American wildlife and plants: a guide to wildlife food habits; the use of trees, shrubs, weeds and herbs by birds and mammals of the U.S. Dover Publications, Inc.

Maryland, State of. (Undated). Shorewaders and other birds associated with Maryland wetlands. Water Resources Administration, Wetlands Section, Annapolis, Maryland.

Maryland, State of. 1965. Classification and inventory of wildlife habitats in Maryland. A planning report for the Maryland Commission on hunting spaces. Maryland State Planning Department.

McAtee, J.L. and N.R. Smith. 1969. J. Colloid and Interface Science. Vol. 29. p. 389-398.

McCaffrey, C. 1975. The major vegetation communities of the Virginia barrier islands; Metomkin Island to Smith Island inclusive. Virginia Coast Reserve Study. The Nature Conservancy, Wachapreague, Virginia.

Metzger, R.G. 1973. Welands in Maryland. State of Maryland Dept. of State Planning. Baltimore, Maryland.

Miller, M.C., J.C. Bacon, and I.M. Lissauer. 1975. A computer simulation technique for oil spills off the New Jersey-Delaware coastline. U.S. Coast Guard Report CG-O-171-75. U.S. Dept. of Transportation, Washington, D.C. 44p.

Milling, M. 1976. Geologic factors controlling foundation design. Ocean Engineering. 48(3):12-2.

Moffitt, J., and C. Cottam. 1941. Eelgrass depletion on the Pacific coast and its effect upon black brant. U.S. Fish and Wildlife Ser. Wildl. Leafl. No. 204. 26 p.

Moore, Stephen F., Robert L. Dwyer and Arthur M. Katz. 1973. A preliminary assessment of the environmental vulnerability of Machias Bay, Maine to oil supertankers. Tech. Report. No. 162. Ralph M. Parsons Laboratory, Dept. Civil Engineering, MIT.

Mulford, R.S. 1972. Phytoplankton of the Chesapeake Bay. In A.J. McErlean (ed.) Biota of the Chesapeake Bay. Chesa. Sci. Vol. 13, Supp.

New Jersey, State of. 1973. Wetland ecology: marsh destruction. Job Progress Report No. I-G. Proj. No. W-53-R-1.

New Jersey, State of. 1975. Hackensack meadowlands: a summary of the Hackensack meadowlands development commission master plan for the protection and orderly development of the meadowlands resources. Hackensack Meadowlands Development Commission, Lyndhurst, New Jersey. Report. No. HMDCZM/2773/10M/5-75.

New Jersey, State of. 1975. Wetlands ecology: aerial surveys. Job Progress Report I-B. Project No. W-53-R-3. September 1, 1974 to May 31, 1975.

North Atlantic Regional Water Resources Study. Water supply (appendix R). 1972. North Atlantic Division Corps of Engineers. 193 p.

Odum, H.T., B.J. Copeland and E.A. McMahan. 1974. Coastal ecological systems of the United States. The Conservation Foundation, Washington, D.C.

Oil and Gas Journal. 1974. NE Atlantic, Celtic Sea "slightly worse." Oil and Gas J. 72(22): 121-150.

Oil and Gas Journal. 1976. U.S. offshore frontiers: how promising are they? 74(3): 17-22.

Ott, F.D. 1972. Macroalgae of the Chesapeake Bay. In A.J. McErlean (ed.) Biota of the Chesapeake Bay. Chesa. Sci. Vol. 13, Supp.

Paradiso, J.L. and C.O. Handley, Jr. 1965. Checklist of the mammals of Assateague Island. Chesa. Sci. Vol. 6, No. 3. p. 167-171.

Patterson, M.M. 1976. Oceanographic data from hurricane Camille. J. Petro. Tech. 28:345-351.

Pfitzenmeyer, H.T. 1961. Benthic shoal water invertebrates from tidewaters of Somerset County, Maryland. Contri. No. 179, Maryland Department of Research and Education, Solomons, Maryland.

Pfitzenmeyer, H.T. 1972. Molluscs of the Chesapeake Bay. In A.J. McErlean (ed.) Biota of the Chesapeake Bay. Vol. 13, Supp.

Phillips, R.C. 1974. Temperate grass flats. In Coastal ecological systems of the United States. Vol. 2. The Conservation Foundation, Washington, D.C.

Press, F. 1975. Earthquake prediction. Scientific American, Vol. 232, No. 5. p.14-23.

Pritchard, D.W. 1972. Salinity distribution and circulation in the Chesapeake Bay estuarine system. J. Mar. Res. 11(2): 106-123.

Resource Planning Associates. 1976. Identification and analysis of mid-Atlantic onshore OCS impacts prepared for the Middle Atlantic Governors' Coastal Resource Council.

Ribichaud, B. and M.F. Buell. 1973. Vegetation in coastal New Jersey. Rutgers University Press, New Brunswick, New Jersey.

Rice, S.D. 1973. Toxicity and avoidance tests with Prudhoe Bay oil and pink salmon fry. Proc. Joint Conf. on Prevention and Control of Oil Spills, March 13-15, 1973. Washington, D.C.

Seity, R.C. 1971. Drainage area statistics for the Chesapeake Bay: an evaluation. Chesa. Bay Inst. Ref. No. 71-1. 21 p.

Shaw, D.R. 1975. Toxicity of drilling fluids, their testing and disposal. In Environmental aspects of chemical use in well-drilling operations, May 1975. Houston, Texas. p. 463-471.

Sidhu, G.S., G.L. Vale, J. Shipton and K.E. Murray. 1970. Nature and effects of a kerosene-like taint in mullet (Mugil caphalus). FAO tech. conf. mar. pollut. Rome, Italy. pap. E-39.

Sieck, H.C. 1975. High resolution geophysical studies for resource development and environmental protection. In Offshore Technology Conference proceedings, 7th annual meeting. Vol. 1: 321-332.

Small, E.B. 1972. Free-living protozoa of the Chesapeake Bay exclusive of foraminifera and the flagellates. In A.J. McErlean (ed.) Biota of the Chesapeake Bay. Chesa. Sci. Vol. 13, Supp.

Stevenson, R.E. and K.O. Emery. 1958. Marshlands at Newport Bay, California. Allan Hancock Foundation Pub. Occ. Paper 20.10 R.

Street, J. Personal communication. 1976. State of Delaware Department of Natural Resources and Environmental Control. Water Resources Section. Dover, Delaware.

Sullivan, M.J. 1971. Distribution and ecology of edaphic diatoms in the Canary Creek saltmarsh. Master's thesis, U. Delaware, Dept. of Biological Sciences.

Tetra Tech. 1974. The effect of natural phenomena on OCS gas and oil development. Prepared for CEQ, Tetra Tech contract T/C 367. Pasadena, California. 100 p.

U.S. Army Corps of Engineers. 1973. Chesapeake Bay: existing conditions report. Appendix C. The bay, processes and resources. Washington, D.C.

U.S. Army Corps of Engineers, 1973b. Chesapeake Bay: existing conditions reports. Appendix B: the land-resources and use. Vol. 2.

U.S. Department of Commerce. 1973b. Environmental conditions within specified geographical regions: offshore east and west coasts of the United States and in the Gulf of Mexico. National Data Buoy Center (NOAA). Washington, D.C. 735 p.

Van Valkenburg, S. 1972. Nannoplankton of the Chesapeake Bay. In A.J. McErlean (ed.) Biota of the Chesapeake Bay. Chesa. Sci. Vol. 13, Supp.

Williams, A.B. 1972. Decapod crustaceans of the Chesapeake Bay. In A.J. McErlean (ed.) Biota of the Chesapeake Bay. Vol. 13, Supp.

Zitko, V. 1975. Toxicity and environmental properties of chemical used in well-drilling operations. In Environmental aspects of chemical use in well-drilling operations. Houston, Texas. p. 311-326.

APPENDICES

1. Call for Nominations and Tentative Tract Selection for Mid-Atlantic OCS Sale No. 40
2. Memorandum of Understanding Between Bureau of Land Management and U.S. Geological Survey for the Geological Survey for OCS Pipelines
3. Secretarial Order No. 2974
4. Oil and Gas Operations
5. Memorandum from Mobil Oil Canada, Ltd. to EXXON Company, U.S.A.
6. Soil Limitations
7. Summary of U.S. Coast Guard Regulations Concerning Offshore Structures as Hazards to Navigation
8. Traffic Separation Schemes: New York and New Jersey Harbor, Delaware Bay, and Chesapeake Bay
9. Influences of Petroleum Hydrocarbons and Heavy Metals on Marine Food Webs
10. Matrix Tables
11. Proposed Operating Orders - Mid-Atlantic Outer Continental Shelf
12. Title 30 Code of Federal Regulations Part 250.34, Drilling and Development Program

APPENDIX 1

CALL FOR NOMINATIONS AND TENTATIVE TRACT SELECTION FOR MID-ATLANTIC OCS SALE #40

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

MID-ATLANTIC OUTER CONTINENTAL SHELF (TENTATIVE SALE #40)

Call for Nominations of and Comments on Areas for Oil and Gas Leasing

Pursuant to the authority prescribed in 43 CFR 3301.3 (1973), nominations are hereby requested for areas in the Mid-Atlantic Outer Continental Shelf (OCS) for possible oil and gas leasing under the Outer Continental Shelf Lands Act (43 U.S.C. 1331-1343 (1970)). Nominations will be considered for any or all of that part of the following mapped area landward of a line beginning at the SW corner of block 971, found on OCS Official Protraction Diagram NJ 18-6; thence north to the NW corner of block 883; thence east to the SW corner of block 843; thence north to the NW corner of block 667; thence east to the SW corner of block 628; thence north to the NW corner of block 540; thence east to the SW corner of block 498; thence north to the NW corner of block 366; thence east to the SW corner of block 326; thence north to the NW corner of block 194; thence east to the SW corner of block 152; thence north to the NW corner of block 64; thence east to the SW corner of block 22; thence north to the NW corner of block 990, found on OCS Official Protraction Diagram NJ 18-3; thence east to the SW corner of block 947; thence north to the NW corner of block 859; thence east to the SW corner of block 819; thence north to the NW corner of block 775; thence east to the SW corner of block 734; thence north to the NW corner of block 646 thence east to the SW corner of block 603; thence north to the NW corner of block 471; thence east to the SW corner of block 431; thence north to the NW corner of block 343; thence east to the SW corner of block 276, found on OCS Official Protraction Diagram NJ 19-1; thence north to the NW corner of block 232; thence east to the SW corner of block 190; thence north to the NW corner of block 102; thence east to the SW corner of block 65; thence north to, and ending at the NW corner of block 21; and seaward of a line beginning at the SW corner of block 996, found on OCS Official Protraction Diagram NJ 18-5; thence north to the NW corner of block 820; thence east to the SW corner of block 779; thence north to the NW corner of block 559; thence east to the SW corner of block 518; thence north to the NW corner of block 298; thence east to the SW corner of block 258; thence north to the NW corner of block 962, found on OCS Official Protraction Diagram NJ 18-2; thence east to the SW corner of block 881, found on OCS Official Protraction Diagram NJ 18-3; thence north to the NW corner of block 661; thence east to the SW corner of block 620; thence north to the NW corner of block 400; thence east to the SW corner of block 358; thence north to, and ending at the NW corner of block 6:

OSC OFFICIAL PROTRACTION DIAGRAMS

1. NJ 18-2 Wilmington.
2. NJ 18-3.
3. NJ 19-1.
4. NJ 18-5 Salisbury.
5. NJ 18-6.

This area is located offshore the States of New Jersey, Delaware, Maryland and Virginia (extreme northern part only), and it is at no point closer than 20 miles from the shoreline.

These protraction diagrams may be purchased for $2.00 each from the Environmental Assessment Team Leader, Atlantic Outer Continental Shelf Office, Bureau of Land Management, 6 World Trade Center, Suite 600D, New York, New York 10048. All nominations must be described in accordance with the Outer Continental Shelf Official Protraction Diagrams prepared by the Bureau of Land Management, Department of the Interior and referred to above. Only whole blocks or properly described subdivisions thereof, not less than one quarter of a block, may be nominated.

In addition to requesting nominations of tracts for possible oil and gas leasing within the specified areas, this notice also requests the identification of particular tracts recommended to be either specifically excluded from oil and gas leasing or leased only under special conditions because of conflicting values and environmental concerns. Particular geological, environmental, biological, archaeological, socioeconomic or other information which might bear upon potential leasing and development of particular tracts is requested where available. Information on these subjects will be used in the preliminary selection of tracts which precedes any final selection by the Director pursuant to 43 CFR 3301.4. This information is requested from Federal, State and local governments; industry; universities; research institutes; environmental organizations; and members of the general public. Comments may be submitted on blocks or portions thereof, as required for nominations, or on all areas or portions thereof as described above. They should be directed to specific factual matters which bear upon the Department's decision whether to make a preliminary selection of particular tracts within these areas for further environmental analysis pursuant to the National Environmental Policy Act of 1969 (42 U.S.C. 4321-4347 (1970)), and possible leasing. Comments relating to general matters which would be applicable to oil and gas operations in any part of the OCS are not sought at this time.

Nominations and comments should be submitted not later than June 2, 1975, in envelopes labeled "Nominations of Tracts for Leasing on the Outer Continental Shelf—Mid-Atlantic" or "Comments on Leasing on the Outer Continental Shelf—Mid-Atlantic," as appropriate. They must be submitted to the Director, Bureau of Land Management, Attention: 720, Department of the Interior, Washington, D.C. 20240. Copies must be sent to the Conservation Manager, Geological Survey, Eastern Region, suite 316, 1825 K Street, NW., Washington, D.C. 20006 and to the Environmental Assessment Team Leader, Atlantic Outer Continental Shelf Office, Bureau of Land Management at his address cited above.

This call for nominations and comments does not in any way commit the Department to leasing in the Mid-Atlantic. It is an information gathering component of the Department's leasing procedure.

Final selection of tracts for competitive bidding will be made only after compliance with established Departmental procedures and all requirements of the National Environmental Policy Act of 1969. Notice of any tracts finally selected for competitive bidding will be published in the FEDERAL REGISTER stating the conditions and terms for leasing and the place; date and hour at which bids will be received and opened.

CURT BERKLUND,
Director,
Bureau of Land Management.

Approved: March 21, 1975.

ROGERS C. B. MORTON,
Secretary of the Interior.

[FR Doc.75-7746 Filed 3-25-75;8:45 am]

Unofficial Reproduction

DEPARTMENT OF THE INTERIOR NEWS RELEASE

BUREAU OF LAND MANAGEMENT

For Release August 20, 1975 Robinson (202) 343-5717

MID-ATLANTIC TENTATIVE TRACT SELECTION ANNOUNCED FOR PROPOSED OCS OIL AND GAS LEASE SALE (OCS #40)

A tentative list of 154 tracts totaling 876,750 acres (354,816 hectares) is being made available for a proposed sale of oil and gas leases (OCS #40) on the mid-Atlantic Outer Continental Shelf, the Department of the Interior's Bureau of Land Management announced today.

This proposed sale is tentatively scheduled for May 1976.

On March 26, 1975, the Bureau of Land Management asked industry to nominate tracts on which it would like to bid if a sale is held, and also invited other Federal agencies, State and local governments, environmental groups, and the general public to specify tracts or groups of tracts which in their view, should not be offered in the proposed sale.

The mid-Atlantic area considered in the call for nominations consisted of 1,151 tracts totaling 6.5 million acres (2.6 million hectares). Industry expressed interest in 557 tracts totaling 3.2 million acres (1.3 million hectares).

BLM's recommendation of 876,750 acres (354,816 hectares) was based upon environmental protection and other resource uses, coastal State government concerns, and areas of high interest in oil and gas potential.

Not included in the tentative tract selection list are 71 tracts which the commercial fishing industry requested be eliminated from lease consideration. The decision to eliminate these tracts from the proposed sale offering was made after the fishing industry recommendation was supported by the U. S. Fish and Wildlife Service in Interior, the National Marine Fisheries Service in the National Oceanic and Atmospheric Administration (NOAA), and the views of coastal States.

The mid-Atlantic area for which the call was issued, is off the coasts of New Jersey, Delaware, Maryland, and the extreme northern coast of Virginia. This area, known as the Baltimore Canyon Trough, is about 85 miles wide and about 150 miles long.

The actual area covered in the tentative tract selection announcement lies from 54 to 109 miles offshore Delaware and New Jersey in water from 36 to 173 meters (118 to 571 feet) deep. None of the area now being considered conflicts with known ocean dumping areas.

Representatives from the States of New Jersey, New York, Delaware, Maryland and Virginia were present at the formal BLM-U. S. Geological Survey meetings where the tentative tract selection recommendations were developed.

This tentative tract selection announcement defines the area for the tentative lease sale area and pinpoints the precise areas to be studied in a draft environmental impact statement. A multi-disciplinary team of environmental and other specialists assigned to BLM's Atlantic Outer Continental Shelf Office will begin the preparation of the draft environmental impact statement which is scheduled to be published in October 1975.

The call for nominations and comments and the tentative tract selection are part of the orderly process of a proposed lease sale which conforms with the National Environmental Policy Act of 1969 (NEPA), guidelines issued by the President's Council on Environmental Quality (CEQ), and Interior regulations.

None of these steps, however, constitutes an actual decision to hold an OCS oil and gas lease sale.

Public hearings will be held and comments received on the draft EIS, and the results of those hearings and comments will be reflected in a final EIS. Thirty days after a final EIS has been submitted to the CEQ, the Secretary of the Interior is empowered to decide whether or not to lease and, if leasing is to occur, the size of the lease offering and the special conditions necessary for protection of the environment and other uses.

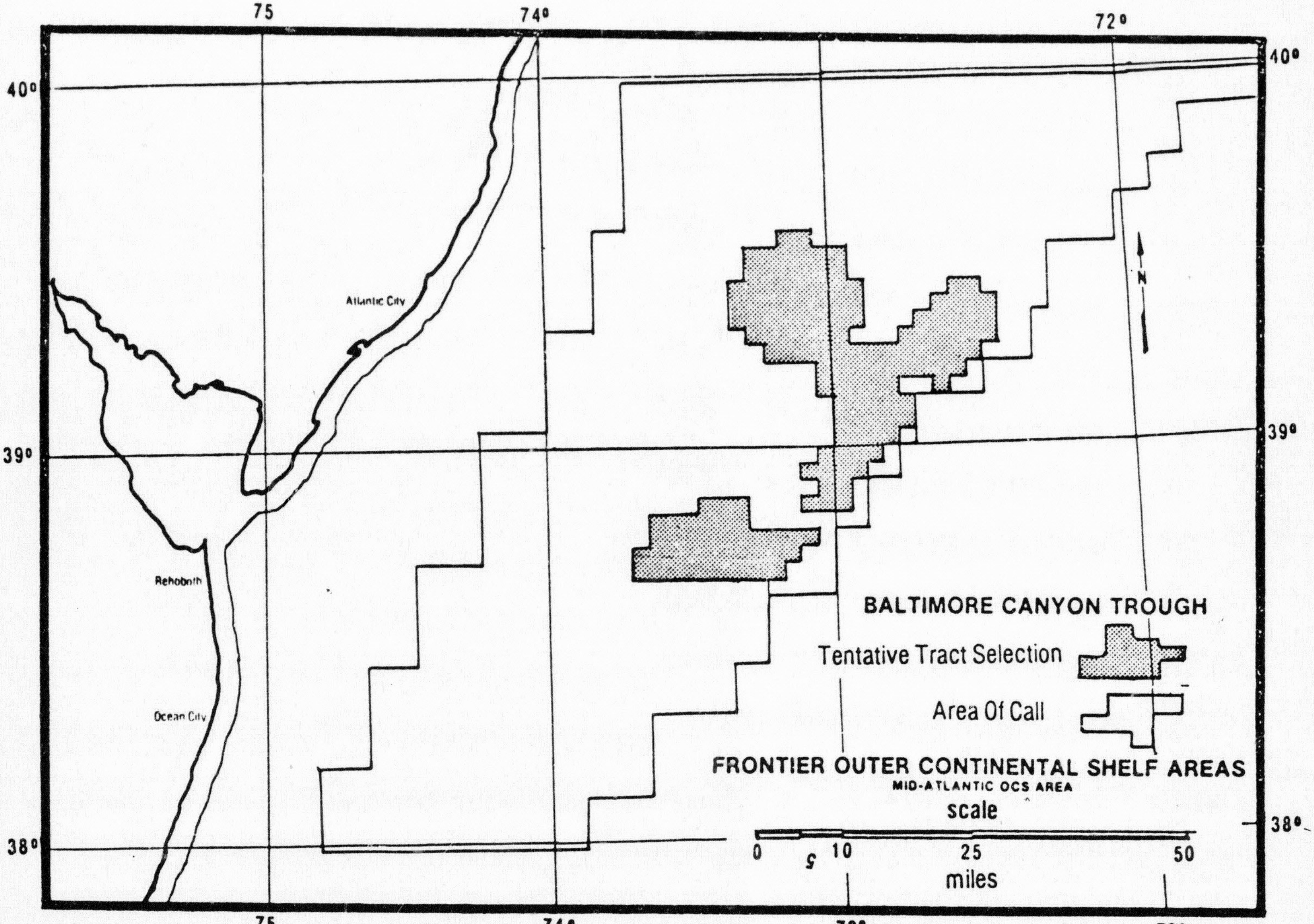
The interval between the call for nominations and comments and the actual decision on whether to hold a sale is generally from a year to 18 months.

The proposed leasing program for frontier areas is part of the Federal effort to reduce dependency on foreign energy sources. The available geologic evidence indicates that the frontier OCS areas hold the most promise for making additional large discoveries of oil and gas.

The frontier OCS areas include the Atlantic Seaboard, certain areas offshore California, and Alaskan offshore waters.

A list of the tracts may be obtained from the Environmental Assessment Team Leader, Atlantic OCS Office, 6 World Trade Center, Suite 600D, New York, New York 10048, or the Bureau of Land Management (720), Washington, D. C. 20240. A map is attached showing the overall mid-Atlantic area in which leasing is proposed.

* * *


75
74°
72°
40°
40°
39°
39°
38°
38°
Atlantic City
Rehoboth
Ocean City
N
BALTIMORE CANYON TROUGH
Tentative Tract Selection
Area Of Call
FRONTIER OUTER CONTINENTAL SHELF AREAS
MID-ATLANTIC OCS AREA
scale
0
5
10
25
50
miles
75
74°
73°
72°

TENTATIVE TRACT LIST
PROPOSED OUTER CONTINENTAL SHELF SALE # 40
MID-ATLANTIC

Official Protraction Diagram No. NJ 18-3

Block	Hectares *	Block	Hectares	Block	Hectares
411	2304	628	2304	729	2304
412	"	629	"	730	"
453	"	630	"	765	"
454	"	631	"	766	"
455	"	632	"	767	"
456	"	633	"	768	"
457	"	634	"	769	"
458	"	635	"	770	"
497	"	639	"	771	"
498	"	640	"	772	"
499	"	641	"	773	"
500	"	642	"	809	"
501	"	643	"	810	"
502	"	673	"	811	"
540	"	674	"	812	"
541	"	675	"	813	"
542	"	676	"	816	"
543	"	677	"	854	"
544	"	678	"	855	"
545	"	682	"	856	"
546	"	683	"	857	"
547	"	684	"	858	"
553	"	685	"	898	"
554	"	686	"	899	"
584	"	687	"	900	"
585	"	718	"	901	"
586	"	719	"	902	"
587	"	720	"	942	"
588	"	721	"	943	"
589	"	722	"	944	"
590	"	723	"	945	"
591	"	724	"	985	"
596	"	725	"	986	"
597	"	726	"	987	"
598	"	727	"	988	"
599	"	728	"		

* each standard block (2,304 hectares) contains 5,693.184 acres

Note: Water depths and distance to shore can be found in Appendix ,
Matrix Tables.

Official Protraction Diagram No. NJ 18-6

Block	Hectares	Block	Hectares
16	2304	189	2304
17	"	190	"
18	"	191	"
19	"	192	"
61	"	226	"
62	"	227	"
98	"	228	"
99	"	229	"
100	"	230	"
104	"	231	"
105	"	232	"
106	"	233	"
139	"	234	"
140	"	235	"
141	"	270	"
142	"	271	"
143	"	272	"
144	"	273	"
183	"	274	"
184	"	275	"
185	"	276	"
186	"	277	"
187	"	278	"
188	"		

APPENDIX 2

MEMORANDUM OF UNDERSTANDING

BETWEEN

BUREAU OF LAND MANAGEMENT AND U.S. GEOLOGICAL SURVEY

FOR

THE GEOLOGICAL SURVEY FOR OUTER CONTINENTAL SHELF PIPELINES

This Memorandum of Understanding is entered into in order to define clearly the administrative and operational roles of the Bureau of Land Management (BLM) and the Geological Survey (USGS) relating to pipelines on the Outer Continental Shelf (OCS), to provide consistent and standardized procedures, and to minimize or eliminate dual and overlapping functions.

Unless otherwise provided herein, pipelines are defined as any line transporting oil, gas, water, sulphur or other minerals, including lines sometimes referred to as flow or gathering lines.

The objectives of this Memorandum of Understanding are to:

A. Provide an efficient mechanism for approving pipeline routes through the submerged lands of the OCS.

B. Initiate measures to provide safety and to minimize or eliminate environmental damage which may be associated with the installation and operation of pipelines originating on the OCS.

C. Be responsive to the interests of the oil and gas industry, other users of the OCS, and the public with respect to pipelines.

D. Streamline implementation of the regulations and procedures for more efficient and uniform administration of the Department's authority with respect to pipelines.

PIPELINE MANAGEMENT

I. BLM ROLE

A. Conduct pipeline routing studies and, with the concurrence of the USGS, designate pipeline corridors on the OCS for all pipelines other than flow or gathering lines within the confines of a single lease or group of contiguous leases under unitized operation or a single operator.

B. Maintain a central office of record for the location of all existing and future pipelines as specified in paragraph I.A. and associated structures on the OCS.

C. Receive applications for rights-of-way for pipelines to be installed on the OCS pursuant to 43 U.S.C. 1334(c) and 43 CFR 2883.

other uses of the OCS and its superjacent waters. The BLM will issue a decision granting the right-of-way after having been notified in writing by the USGS that the technical aspects of the proposed pipeline are acceptable. BLM will prepare environmental assessments and impact statements prior to granting such pipeline rights-of-way when necessary or appropriate.

2. The USGS will approve rights of use and easement for gathering and flow lines pursuant to 30 CFR 250.18 and 250.19. For any such pipelines other than flow or gathering lines within the confines of a single lease or group of contiguous leases under unitized operation or a single operator, the USGS will transmit a copy of the pipeline application to the BLM. The BLM will review the application as to whether the pipeline route conflicts with any existing or proposed pipeline and pipeline corridors or would otherwise not be consistent with good pipeline management for the OCS. The BLM will advise the USGS in writing of the results of its review prior to a USGS determination for approval or disapproval of the application.

3. The BLM will conduct field studies relating to the immediate and long term environmental impact of pipelines and associated structures on the OCS in order to assess the adequacy of environmental safeguards. Reports of the results of the BLM field studies with recommendations for minimizing the impact of pipelines on the environment will be released to the public and distributed to appropriate agencies with jurisdiction over pipelines on the OCS.

4. The BLM and USGS will periodically review existing procedures for reviewing applications and issuing rights-of-way and rights of use and easements and propose improvements in such procedures as appropriate. The procedures shall include the assessment of the environmental impact and the minimization of the number and locations of pipelines on the OCS.

5. The BLM and USGS will consult with each other in the preparation of environmental analyses and impact statements and will also consult with the Bureau of Sport Fisheries and Wildlife, the National Park Service, the Bureau of Outdoor Recreation, and other Federal and State agencies as appropriate.

6. The BLM will assume the responsibility for overall studies of pipeline routing on the OCS and, with the concurrence of the USGS, designate pipeline corridors for all pipelines other than flow or gathering lines within the confines of a single lease or group of contiguous leases under unitized operation or a single operator. To assist

D. Prepare environmental assessments, pipeline system planning studies, economic studies, and environmental impact statements when necessary or appropriate, prior to approving applications for rights-of-way pursuant to 43 U.S.C. 1334(c) and 43 CFR 2883.

E. After considering the potential impact of the pipeline on the environment, the relationship of the application to existing pipeline routes on the OCS, and other factors, approve or disapprove the application pursuant to 43 CFR 2883.

F. Conduct field studies relating to the long range environmental impact of all pipelines and associated structures, thereby providing a basis for continuous assessment of existing environmental safeguards applied to such pipelines.

II. USGS ROLE

A. Consider all applications from a lessee or operator for a right of use and easement to construct and maintain pipelines and associated structures on the OCS pursuant to 30 CFR 250.18 and 250.19. Prior to granting approval of such applications for any pipeline other than flow or gathering lines within the confines of a single lease or group of contiguous leases under unitized operation or a single operator, consult with the BLM so that the routing of such pipelines may be coordinated with existing lines or designated pipeline corridor.

B. Review technical aspects of OCS pipeline design, installation, maintenance and operation in accordance with appropriate regulations and standards designed for safety and environmental protection, and to avoid undue interference with other uses of the OCS and its superjacent waters.

C. Prepare environmental assessments or impact statements when necessary prior to approving applications filed pursuant to 30 CFR 250.18 and 250.19.

D. Provide the BLM with the location, as installed, of all pipelines approved by the USGS as specified in paragraph II.A.

PROCEDURES

1. BLM will receive right-of-way applications pursuant to 43 CFR 2883 for pipelines and associated structures for the transportation of oil, gas, sulphur and other minerals on the OCS. A copy of the application will be sent to USGS for review. The reviews by USGS will focus on the technical aspects of OCS pipeline design, installation, maintenance and operation in accordance with appropriate regulations and standards designed for safety and environmental protection, and to avoid undue interference with

in this, the USGS will furnish BLM with a copy of all approvals and drawings showing the proposed and installed locations of all pipelines, as described in this paragraph, and associated structures erected in connection with approvals of rights of use and easements.

AUG 1 1974
Date

V. E. McKelvey
Director, USGS

AUG 1 1974
Date

George L. Turcott
Director, BLM

APPENDIX 3

SECRETARIAL ORDER NO. 2974

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

APR 30 1975

ORDER NO. 2974

Subject: Inter-bureau coordination in the Outer Continental
Shelf (OCS) minerals program

Sec. 1 Purpose. The purpose of this order is to improve and formalize the planning and operating functions of the OCS minerals program by enabling the Bureau of Land Management (BLM) and the Geological Survey (USGS) to obtain expert advice from each other and from the Fish and Wildlife Service (FWS) with respect to environmental research and monitoring and operational activities associated with the OCS minerals program.

Sec. 2 Environmental Research and Monitoring. Environmental research and monitoring activities are those data collection activities conducted in specific geographic areas as a part of the OCS mineral leasing program. These activities are carried out in the context of a BLM program for administration, management, funding, and constructing of baseline studies, which includes bench mark data collection, subsequent monitoring, and special investigations. For the purpose of this order, bureau responsibilities are as follows:

(a) The BLM will consult with FWS and others, as appropriate, in designing the studies. In this connection, BLM will inform FWS of its study plan schedule and request FWS recommendations concerning:

(1) specific elements to be incorporated in studies (including scope, intensity, timing, required funding, etc.)

(2) allocation of funds and level of effort among various study elements.

(b) FWS and BLM shall, by mutual agreement, provide for FWS involvement in the performance or management of studies under any of the arrangements detailed below:

(1) FWS may perform or manage particular studies or specific study elements as may be determined by mutual agreement among FWS, BLM, and others as appropriate. BLM and FWS shall develop a memorandum of understanding which provides for reimbursement of stipulated study costs to FWS and other pertinent activities under this arrangement.

(2) FWS may perform or manage elements of a larger study which another Federal agency manages for BLM. In this instance, FWS would arrange with the other Federal agency for its participation.

(3) FWS, acting in effect as sub-contractor, may perform or manage elements of a comprehensive study effort which is managed for BLM by a contractor, e.g., a university consortium.

(c) FWS will participate with BLM and others as appropriate, as a member of the OCS Technical Proposal Evaluation Committee.

(d) FWS will participate with BLM in monitoring those study elements of special interest to FWS.

(e) FWS will participate in the overall study program design for each separately identified geographical area in which baseline or other studies are planned.

(f) If, for good and sufficient reasons, FWS does not agree with the overall study program designs as prescribed in paragraph (e) above and is unable to secure mutually acceptable changes through discussions with BLM, the issues will be referred for resolution through the appropriate Assistant Secretaries to the Assistant Secretary - Program Development and Budget (AS-PD&B).

Sec. 3 OCS Operational Activities. OCS operational activities refer to the implementation of OCS regulations administered by BLM under 43 CFR, Part 3300 and USGS under 30 CFR, Part 250.

(a) When an OCS area is initially being considered for leasing, the Director, BLM, shall request, pursuant to 43 CFR 3301.2, a Fish and Wildlife resources report from the Director, FWS. Such reports may include but are not limited to:

(1) Information concerning results of periodic studies on problems relating to the impact of mineral exploration and exploitation on estuarine and coastal resources.

(2) Information which relates directly or indirectly to the assessment of potential environmental impact of the administration and supervision of mineral exploration and production on OCS lands by BLM or USGS.

(3) Information useful in the identification and designation of restricted use areas including, but not limited to, Marine Preserves, Marine or Estuarine Sanctuaries and National Wildlife Refuges.

(b) During the period when tracts are evaluated for leasing, the manager of the appropriate OCS Office, BLM, shall obtain the views of the appropriate Regional or Area (Alaska) Director, FWS, concerning the potential effects of oil and gas development on biotic and other resources.

(c) BLM, in the writing of any special lease stipulations that may be required to protect biotic and other resources, shall obtain the advice and participation of FWS and USGS.

(d) BLM will give FWS the opportunity to review Notices of Lease Offer and to make written recommendations thereon, prior to their publication in the Federal Register.

(e) BLM, with the participation of FWS and others as appropriate, will plan the alignment of pipelines which will extend between OCS and onshore locations. The FWS should prepare and submit reports to BLM concerning the potential effects on biotic resources of placement of pipelines along such alignments.

(f) The appropriate Area Oil and Gas Supervisor, USGS, will consult with and receive recommendations from the appropriate Regional or Area (Alaska) Director, FWS and the appropriate OCS Area Manager, BLM:

(1) Prior to issuance of draft OCS orders.

(2) Prior to granting rights of use or easements to lessees to construct and maintain platforms, fixed structures, artificial islands and pipelines on areas of the OCS.

(3) Prior to approval of the design and plan of installation of platforms, fixed structures, artificial islands and pipelines.

(4) Prior to approval of exploratory drilling plans.

(5) Prior to approval of plans of development.

(g) In order to implement the consultative procedures described in Section 3(f) above, USGS will send copies of all relevant documents to the appropriate representatives in FWS and BLM. USGS will defer final action until FWS and BLM have indicated their intention to offer recommendations or until ten days have elapsed, at which time FWS and BLM will be presumed to have no recommendations to offer. If either FWS or BLM has, during this ten-day period, notified USGS of its intention to comment, USGS shall defer final action until the written recommendations are received or until twenty days have elapsed from the date of receiving such notice.

(h) BLM, with the participation of FWS, will design any biological sampling or monitoring plan that may be required in connection with special lease stipulations for the protection of biotic resources.

Sec. 4 Committees. (a) A committee will be formed at the headquarters level consisting of representatives from AS-PD&B, FWS, BLM, USGS and the Solicitor's Office to serve as the formal mechanism for coordination and planning, implementing the provisions in Sections 1 to 3, and providing a forum for exchanging of views among the participants. The chairman of the committee will be the representative of AS-PD&B. Meetings will be scheduled at least monthly, and more frequently if necessary, at the call of the chairman. Provision may be made for convening special meetings at the call of any participating agency.

(b) Field-level committees will be formed for Mid-Atlantic, North Atlantic, Gulf of Mexico, Southern California, Alaska and, at the direction of the AS-PD&B, any other regions where OCS field operations are centered and will consist of representatives from all the agencies and offices named in Section 4(a). The field-level committees will serve as the formal field-level mechanism for coordination and planning, implementing the provisions in Sections 1 to 3, and providing a forum for exchanging of views among the participants. The chairmen of the field committees will be appointed by the top ranking field level officials of the involved agencies and offices and meetings will be arranged in the same manner as described for the headquarters committee. For reasons of economy and convenience, the members of the committee may decide to confer by telephone rather than meet as a group.

(c) The committees described in this Section shall be established and operate in accordance with the provisions of 308 DM 4.

Sec. 5 Resolution of Disagreements. If BLM, USGS and FWS disagree for good and sufficient reasons on any of the operational aspects detailed in Section 3, the matter in dispute will be resolved as follows:

(a) If it is a field level issue, it will first be considered together by the appropriate top ranking representatives of BLM, USGS and FWS. If the issue cannot be resolved satisfactorily in this manner, it will be referred for resolution to the concerned Directors at headquarters level.

(b) If it is a policy issue or one which is otherwise handled at headquarters level, the issues will be referred for resolution through the appropriate Assistant Secretaries to AS-PD&B.

Sec. 6 Effective Date. This Order is effective immediately. Its provisions shall remain in effect until the Order is amended, superseded or revoked, whichever occurs first. However, in the absence of the foregoing actions, the provisions of this Order shall terminate on December 31, 1976. A comprehensive review of experience in implementing the Order shall be made by the AS-PD&B by November 30, 1976, with the objective of recommending an appropriate course of action.

Rogers C B Morton

Secretary of the Interior

APPENDIX 4

OIL AND GAS OPERATIONS

Description of Offshore Operations Expected in the Mid-Atlantic OCS

Exploration

Before drilling commences on any tracts that may be leased in this proposed Mid-Atlantic sale area, additional geophysical studies may be conducted (after obtaining permission of the United States Geological Survey) in order to further define the location of prospects, design the drilling mud program and coring strategies, and choose the safest drilling sites.

In seismic exploration, a ship travels along a predetermined path, towing signal generating and recording equipment. The signal generated by the energy source is a series of small amplitude seismic pulses that travel at the speed of sound through the water and sediment below, where they are reflected and refracted by the underlying strata. An array of sensitive detectors towed by the vessel receive incoming seismic waves which are then recorded on magnetic tape. After extensive computer processing, the recordings are displayed in the form of vertical cross-sections. The seismic profiles are then interpreted to identify the location, size and shape of geologic structures favorable to oil and gas accumulation. This information is normally displayed as a series of subsurface seismic contour maps.

It is assumed that the generation of signals will be by sources other than dynamite since these modern devices, which include sparkers, air guns and gas guns have become widely accepted and account for over 95% of marine seismic energy sources currently in use.

Industry officials anticipate that drilling rigs will be brought up from the Gulf of Mexico and that jack-ups, semi-submersibles, and drillships will be used.

The bottom supported rigs (jack-ups) are floated from one location to another, and are most vulnerable to damage or loss while in transit. Shallow (less than 350 feet or 100 meters) water exploratory drilling is commonly carried out using a "jack-up" type drilling rig (see Figure while deeper waters require the use of semi-submersible rigs or drill ships. The jack-up rig is towed into position and the legs jacked downward to contact the bottom and lift the platform 30 to 50 feet above the water surface.

Semi-submersibles are large, advanced-design floating rigs that have better motion characteristics in rough seas than do ships or barges (see Figure 1). These rigs are floated to the site, partially submerged and held in place by anchors. These units can work in water depths up to 1000 feet and beyond. The semi-submersibles as well as drillships, if used, would be connected to seafloor equipment by buoyant riser pipes.

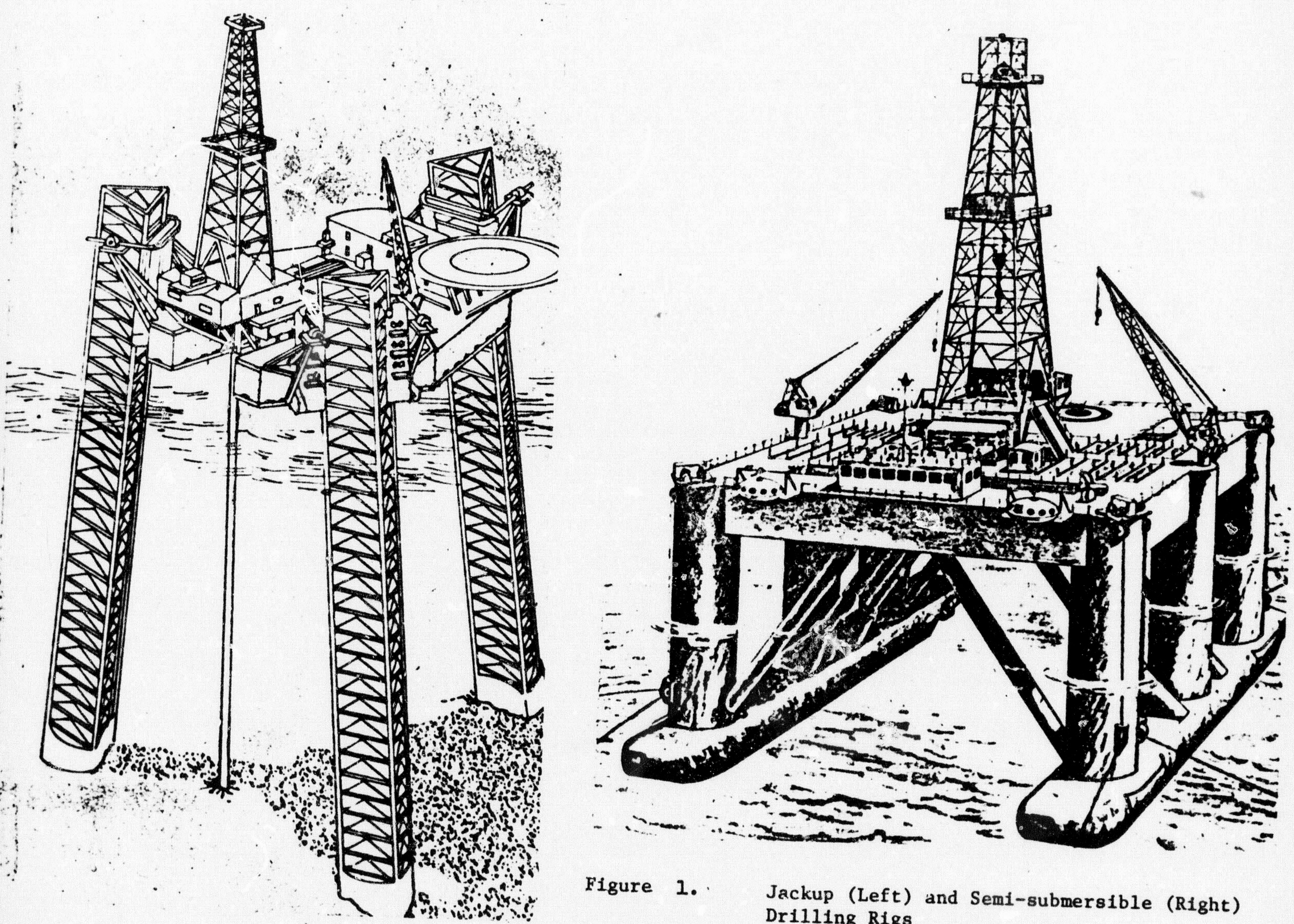


Figure 1. Jackup (Left) and Semi-submersible (Right) Drilling Rigs

Winds, waves and ocean currents tend to push floating drill platforms off location regardless of how good the mooring system. This can put excessive stresses on a riser. One company uses an acoustic position reference system whereby acoustic signals from a beacon located near the wellhead on the seafloor are received by three shipboard hydrophones (see Figure 2). In use, the vessel's position is determined by comparing, at each of the three shipboard hydrophones, the signal either emitted by or reflected from the seafloor beacon. The correct position, with reference to the wellbore, is shown on the shipboard console viewing screen and the vessel kept in position by adjusting mooring lines or using the ships engines plus special horizontal thruster engines. If, for some reason the drillship should have to move off location, the seafloor beacon or reflector is used to reposition the vessel upon return.

Once the drilling rig is in place, the drive pipe, blowout preventers and riser are installed. Drilling then commences with drilling mud circulating through the well bore to provide pressure control, lubrication of the drill bit, and circulation of wellbore cuttings out of the hole.

In spite of considerable research, it is still not always possible to predetermine, for wildcat wells, the formation pressure and the fracture pressure that the wellbore will encounter. During drilling there are several means of determining the trend in pressure.

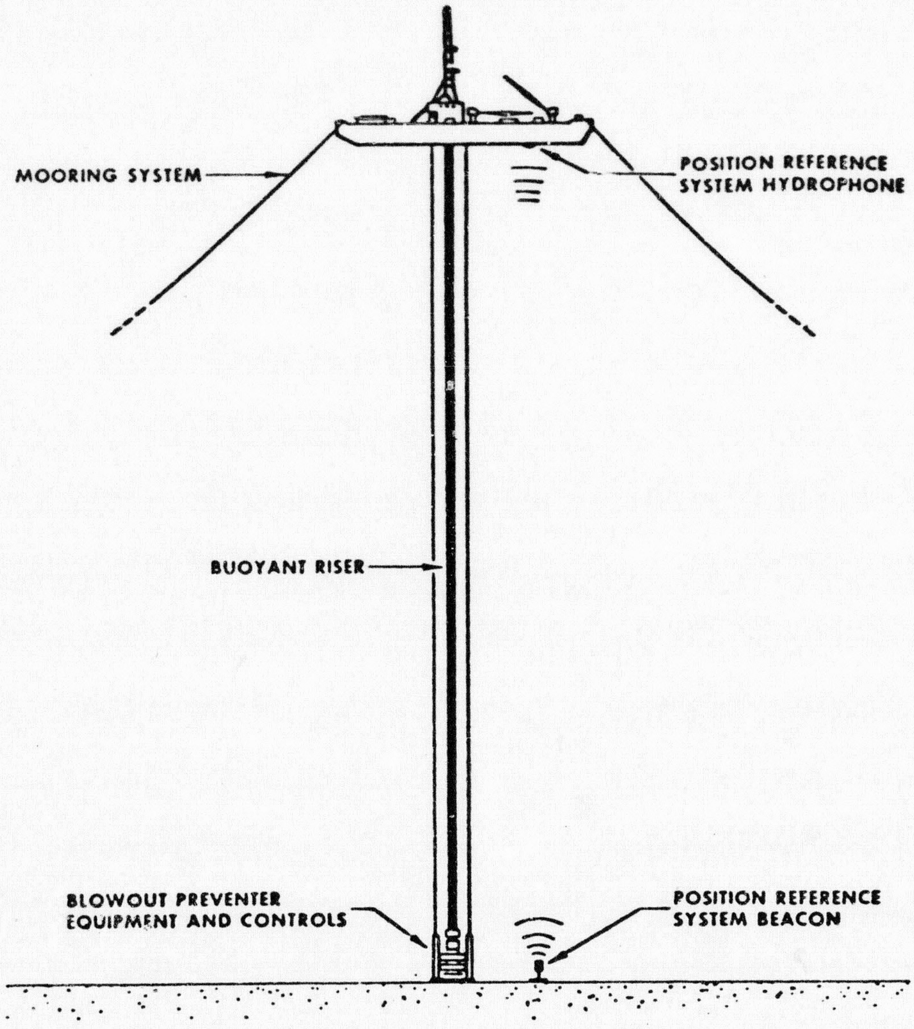

MOORING SYSTEM
POSITION REFERENCE SYSTEM HYDROPHONE
BUOYANT RISER
BLOWOUT PREVENTER EQUIPMENT AND CONTROLS
POSITION REFERENCE SYSTEM BEACON

Figure 2. Drill Ship Operations

They include measurements such as formation temperature (as evidenced by the temperature of the returning mud), shale density and changes in the penetration rate of the drill bit.

If the hydrostatic gradient of the drilling fluid becomes less than formation pressure, a "kick" of gas or other fluid may enter the wellbore from the formation being drilled. The influx displaces some drilling fluid, thereby causing reduction in the hydrostatic head in the annular space between the drillpipe and the borehole (Figure 3).

If the volume of the influx is not excessive, and a surface indication (increased mud tank volume) is observed in time, the unwanted influx of fluid or gas can be circulated out of the well by careful observation of well conditions and adherence to preplanned emergency procedures. From the record of a kick, the bottom-hole pressure can be determined and with this pressure known, the mud weight can be adjusted to provide the correct hydrostatic head for the safe continuation of drilling.

An uncontrolled kick is called a "blowout." Blowouts seldom occur and usually can be controlled by implementation of preplanned emergency procedures and actuation of devices known as "blowout preventers" which are mounted on every offshore well during drilling. Actual blowout preventers used offshore are of at least three types; a bag-type, one with blind rams, and one with pipe rams. Blowout

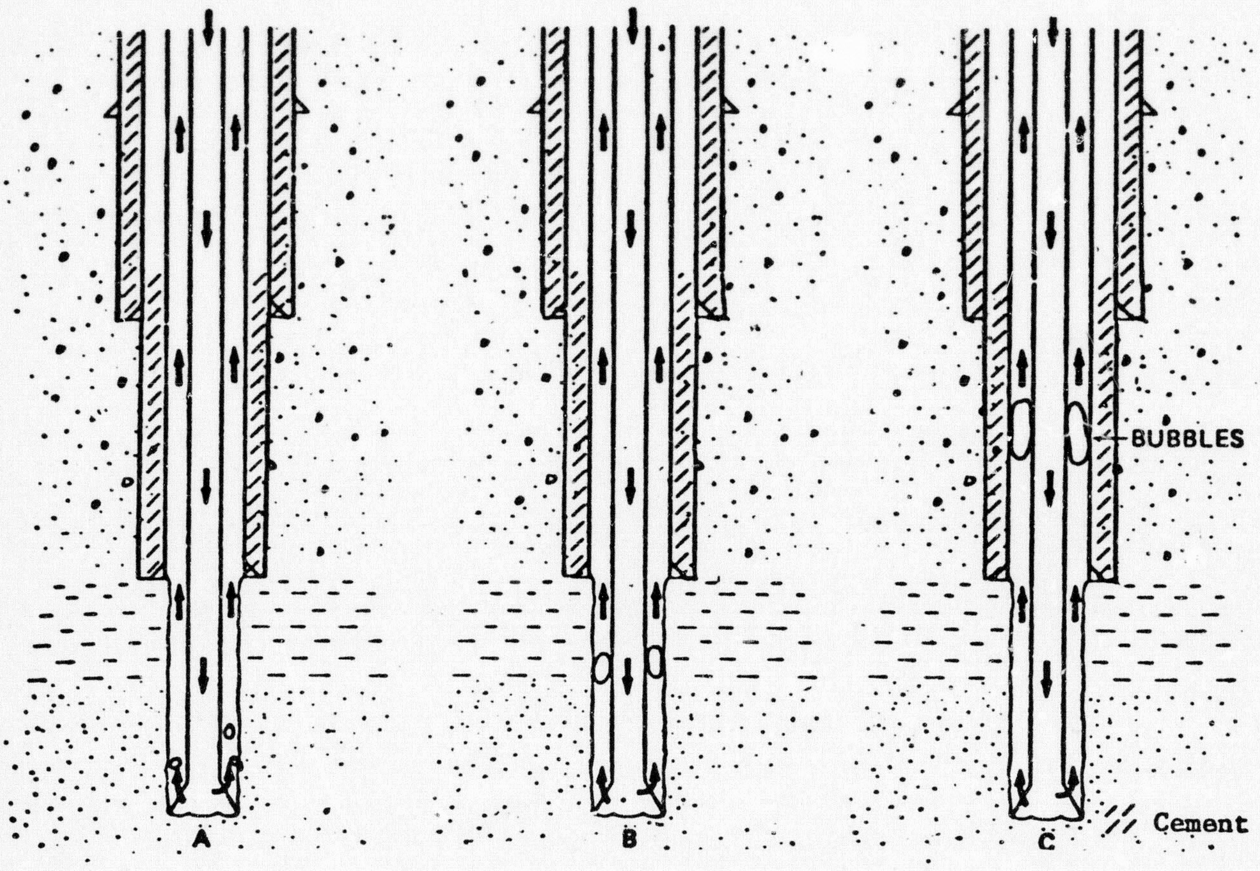


Figure 3. A "kick" is a gas or liquid influx that reduces the hydrostatic head in the annulus. Here, the kick is a gas bubble (A). As it rises (B and C), it expands causing a sudden increase in the upflow of the mud. When the bubble reaches the top, if it has not been allowed to expand, the bottom-hole pressure reaches a maximum--the sum of mud pressure and gas pressure. This pressure maximum, if excessive, can exceed the formation fracture pressure, and lead to a loss of drilling mud to the formation, thus further decreasing the hydrostatic pressure. This could cause an influx of formation fluids into other formations, or the fractured formation taking fluid from another formation, commonly referred to as an underground blowout.

preventers are essentially large valves that can close around the the drill string or across an open hole and seal off the well at the surface. These valves are so powerful that some are equipped with shear rams that can cut the drill pipe should this procedure aid in controlling the well. The blowout preventer stack can also be mounted on the sea floor and remotely controlled at the drilling console. These seafloor BOP stacks are designed to be used in any water depth and have reaction times of 10 seconds or less. Blowouts can occur downhole when a low-pressure formation fractures, and fluids from a higher-pressure zone flow into the fractured formation. Such underground blowouts, like surface blowouts, require the careful use of preplanned emergency techniques to regain control. Blowout preventers and other well-controll equipment must meet the requirements of OCS Orders. This equipment is tested on a schedule set by prudent practice, but not less often than regulations specify.

To ensure that adequate provisions have been made for safety and well control, the casing program and drilling fluid, or mud program must be approved by the Geological Survey before a drilling permit is issued. Along with adequate casing, it is important that enough cement be spotted between the casing and the wall of the hole to seal off and isolate all sensitive geological formations such as hydrocarbon zones and freshwater sands, and to separate zones of abnormal pressure from those with normal pressures. Mud components are described in Chapter III.A.

Should the initial test be dry, an exploratory well is usually plugged and abandoned. Cement plugs are set to confine formation fluids in their parent subsurface formations, to prevent them from intermingling, and to prevent flow to the surface. During plugging operations, well-control equipment remains in use. When a well is abandoned, the casing is cut off well below the mud line, all obstructions are removed, and the bottom is dragged to be sure that no obstructions were overlooked. In some cases, it may be necessary to drill several exploratory wells on each block before a lease is totally condemned.

If well tests show that commercial quantities of natural gas or oil have been found, it may be necessary to drill several additional confirmation tests before the company is satisfied that the reserves will support a development drilling and well completion program. If petroleum deposits prove to be commercial in quantity, one of two courses of action may be followed:

(1) The exploratory well may be deemed expendable and be permanently abandoned. Procedures followed would be the same as above for a dry-hole abandonment.

(2) The well may be deemed useful as a future production well and temporarily abandoned. In this case, a mechanical bridge plug is placed in the smallest string of casing and the well head capped and left for future entry when production activity commences.

This results in the temporary existence of an underwater "stub." The Coast Guard District Commander requires that such stubs be marked by a buoy at the surface if located in 200 feet of water or less, and that the buoy be lighted if located in 85 feet of water or less.

Development

Offshore drilling and production operations are usually conducted on fixed, bottom-founded, water surface-piercing platforms. If exploratory efforts are successful in proving a hydrocarbon reserve, production operations are initiated by installing platforms (Figure 4) to serve as a base for drilling development wells and for subsequent producing operations. A number of wells may be directionally drilled to develop a large area from a single platform.

During the history of OCS oil operations around the world, industry has gained a good understanding of the physical forces acting on offshore platforms. Appropriate design procedures are outlined in API Recommended Practices RP 2A and various API specifications. These guidelines have been prepared to cover engineering design and operation of offshore structures and related equipment. United States Geological Survey Outer Continental Shelf Orders define regulatory approval procedures for platform design and installation.

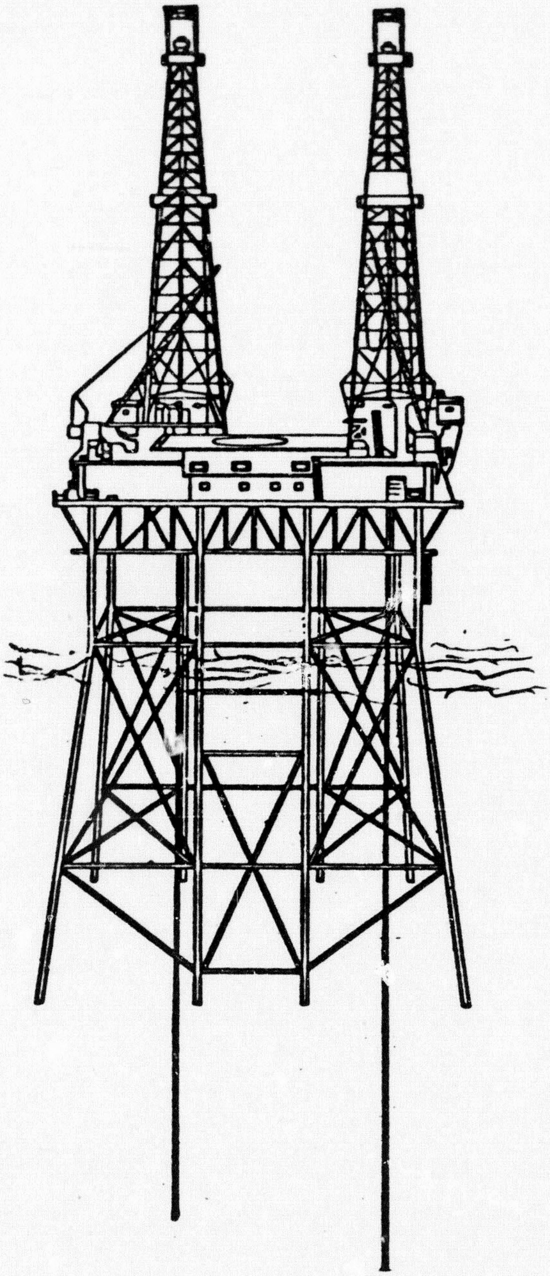


Figure 4. Offshore development platform with drilling rigs in place

There are at least three subsea production systems currently under development which are designed to serve multiple wells. They are described in the following section (Production). Each provides for gathering, measurement, and control of well streams and enable through the flowline (TFL) well maintenance. Subsea completions will result in sea floor obstructions that could foul trawling gear; however should a trawl snag a subsea completion the possibility that it would damage any of the well head assembly to the extent of causing uncontrolled flow is remote because of the strength and durability of the material that would be used in the sea floor structure. The stipulation for marking of subsea completions (IV.E.) also reduces the possibility of this occurence.

Wells usually are produced through tubing placed inside the final or production string of casing. During tubing installation, the blowout preventers remain in use to ensure control of the well. a system of in-tubing safety valves, plus other casing and tubing valves at the surface or sea floor, is installed to control well flow. Actuation is usually at the producing platform.

Of major concern in the operation and control of every production platform are the downhole control devices. Production tubing is fitted with one or more safety valves that are installed and located at least 100 feet below the mud line or sea floor. In the past, velocity actuated choke valves ("storm chokes") designed to shut-off production when the flow rate exceeds predetermined limits have been used. Such valves should close if surface equipment failure results in an excessive flow through the tubing. These chokes are particularly susceptible to failure from internal erosion in areas where sand is produced along with the oil and gas.

Certain types of subsurface fail-safe valves do not depend on the velocity of well fluids for actuation, but are held open by hydraulic or other fluid pressure applied from the surface. The valve is designed to close automatically, shutting off the flow of fluid from the well in the event some undesirable situation on the platform interrupts the pressure holding the valve open. Essentially all wells drilled since December 1, 1972, are equipped with valves that are actuated from the surface. These valves provide highly reliable protection and may be tested frequently to insure proper operation. Their use will increase costs significantly, but the need for more reliable valves has been shown by past incidents in the Gulf of Mexico and elsewhere. The increased degree of safety offered by use of the fail-safe valves should justify their installation.

Technology presently exists to install platforms in water depths to at least 850 feet, and industry contends that the practical limit can be extended to 1200 feet. It is assumed that since water depths encountered in this proposed sale will be 200 meters or less, development drilling and production platforms can be used. In typical template type structures, the lower portion, or jacket, is barged to sea, launched, upended and secured to the sea floor with piling driven through the legs. The deck section is then lifted into place and secured by welding.

The drilling rig, power plants, generators, living quarters, storage sheds and other components, constructed in modular form, are added to the platform, and development well drilling commences. Equipment anticipated for use on deep water platforms is similar to that being used safely in current shallow water operations, and will be installed and operated in accordance with safe practices accumlated from industry experience. These practices are incorporated in OCS Orders and specify multiple, redundant controls and safety devices including safety shut-in valves, high-low pressure pilots, high-low level controls, high-temperature shutdowns, gas detectors, shielded ignitions, fire prevention and detection equipment, and pressure relief systems. Drain and sump systems are also designed to collect any spillage that might occur on the platform. The sequence of drilling operations for development and production wells is essentially the same as for exploratory wells.

Blowout preventers as well as downhole control devices have proven to be extremely valuable, in time of accidents and emergencies, in preventing large amounts of oil from escaping into the environment. When hurricanes have passed through offshore oil and gas fields, entire platforms have been swept away with only a minimal spillage.

Blowout preventers on drilling wells and the redundant combination of wellhead valves and subsurface safety valves have proven effective in maintaining control of wells when the normal controlling devices (drilling mud and production regulators and chokes) have failed. Once shut-in, the wells can be reentered through either the blowout preventers or wellhead valve with drill-pipe or tubing to perform remedial work and bring the well back under control. This can be done if the blowout preventer or wellhead is on the sea floor the same as if they were located on a platform. However, should a well get completely out of control and crater around and outside the surface casing so that the well could not be reentered, then an offset relief would have to be drilled.

As with exploratory drilling, the casing and mud programs for each development well must be approved by the Geological Survey before a drilling permit is issued.

Production

The production platform contains all the equipment and performs the same function as a field gathering station does at an onshore location. The fluid produced from the well is some mixture of gas, oil and water in varying proportions. Depending upon the flowing well head pressure, this mixture may be subject to as many as three stages of gas-oil separation. The stage separation process recovers the driest gas and the largest volume of liquid.

The gas may be further processed through scrubbers to remove any entrained oil, water or other impurities before it is compressed and sent ashore by pipeline. If there is insufficient gas to sell to a trunkline, it may be reinjected into the producing formation as a pressure maintenance measure, used for gas lift, or used as engine fuel to drive pumps and compressors. Only on rare occasions is gas flared and then a permit from the OCS Area Supervisor of USGS is required.

The oil/water mixture that comes from the gas-oil separator goes first to a free water knock-out where the free water is separated by gravity from the oil. Should some water be emulsified with the oil, this mixture is sent through heater and/or chemical treaters to break the emulsion and separate the oil and water. The oil is pumped ashore by pipeline and the water is further filtered and treated to meet EPA effluent standards before being disposed of overboard.

The production platform is basically that of the development platform minus the drilling rigs. Facilities consist of gas-oil separators, oil-water separators, gas scrubbers, compressors, pumps, storage tanks, instruments, and controls. As mentioned previously, multiple redundant controls and safety devices are required by OCS operating orders to prevent accidents and degradation of the environment.

The possibility does exist that subsea completions would be used as a result of this sale. Wells can be drilled vertically from locations conforming to the desired spacing pattern of the field. In this case flow lines are required from each well to a common point. This common point may be either a surface production facility, an ocean floor production and test manifold, or, possibly, a subsea production facility.

There are two principle drawbacks in developing a field in this manner:

> There is a practical limit to the length of flow line that can be considered. Depending on the production characteristics, wellhead pressure and fluid viscosity in particular, there will be a pressure drop per unit length of line. In some cases this pressure drop could be enough to prevent production from reaching the central collecting point and certainly, as the reservoir pressure declines during the life of the field, problems will develop.

Depending on the type of well completion, the production tree in particular, flow line lengths are critical. If the well is to be maintained by divers and/or surface vessels, the flow line length may not be too important, but where maintenance is to be carried out by pump down, through the flow line (TFL) tools, the length of flow line would be important. Also, if the well is to be remotely controlled, hydraulic lines and/or electric cables may be required to actuate well controls. These would normally parallel the flow line.

Normally, subsea wells are drilled within three miles of the central collecting point but longer distances are being planned. If conventionally moored vessels are used in field development, and later in field maintenance, the presence of a number of lines on the sea floor may hinder the use of anchors and increase the hazard of rupturing the lines.

If the productive formation is deep enough below the sea floor, wells can be drilled directionally from a common site on the sea floor to bottom in widely-spaced locations to meet the needs of optimum field spacing. Generally, some type of base plate or template is employed to space well heads. These templates may be elaborate and combine functions other than wellhead spacing or the templates can be simple and merely replace the temporary guide base.

This system is called the cluster concept for subsea completions and the wells can be conveniently connected to a common subsea test and production manifold. In this case only two lines carrying production to the surface are required, one to carry the total production from the cluster and the second to carry an individual well's production to a test facility. Depending on the field development plan, additional lines to handle well and manifold control functions may also parallel the flow lines.

Down hole completion procedures for subsea wells are as discussed above. After tubing is hung and plugged, the BOP stack is removed and the wellhead is set and connected in place.

Wellhead equipment for subsea wells is functionally similar to the equipment described for platform wells and includes all the safety devices previously described. The control equipment is necessarily modified in accordance with the type of basic control design - that is diver operated, remote control from the surface, control at atmospheric pressure in encapsulated well heads, etc.

In the simplest form the subsea production tree can be the same as those used on land. The tree is installed by divers and manipulation of well controls would also require divers. Divers also make up the flow line connections. The tree valves can be controlled hydraulically from a remote point through hydraulic control lines. Four trees of this type were installed by Phillips Petroleum Company in the El Molino Field in the Santa Barbara Channel in 1963 in 200 feet of water.

The problem with diver operated systems is the diver depth, though present working dives are routinely carried out in water depths to 600 feet and they have been carried out in depths of 1080 feet.

A remote controlled, hydraulically manipulated tree is installed without diver assistance using the same techniques as those used to make up blowout preventer and riser pipe connections during drilling. All valves are controlled hydraulically, or electro-hydraulically where distance attenuates hydraulic response time from a remote control point. All valves are also of the fail - close type, which means they will automatically shut in the well should loss of hydraulic pressure occur. Four of these trees are installed in 230 feet of water in the Ekofisk field in the North Sea operated by Phillips Petroleum Company.

An encapsulated tree is a conventional tree installed in a chamber that is maintained at atmospheric pressure and includes a means of access from a personnel vehicle. The personnel vehicle can be considered a diving bell with means of connection to the subsea chamber over the wellhead. In this manner, non-diving technical personnel have access to the wellhead controls and can perform all of the functions possible on a land well, including wire line work.

Several sub-sea production systems have been developed, and they are discussed more fully below. One of these, the Lockhead system, was installed by Shell Oil Company in the Gulf of Mexico in September 1972, in 375 feet of water. In 1973 the well was successfully re-entered for routine maintenance.

This concept can be expanded to include a complete production system. The advantage of course is that well work can be performed at surface conditions (atmospheric pressure) and that the work can be done using conventional oil field tools and techniques with no reliance on sophisticated remote control techniques. These systems are presently viable to at least 1,500 feet and even greater depths can be anticipated in the future.

A subsea manifold would perform the same funtion as a manifold on a surface production installation. The purpose of this series of valves is to collect the production from several wells and combine it to a single stream for delivery to a separation facility. There must also be a means of segregating individual well production for metering and testing. This is accomplished by the series of valves included in the manifold.

The manifold, which can be operated hydraulically or electro-hydraulically from a remote control point can be "wet" or it can be encapsulated. The value of such a system is to permit a cluster of subsea wells and avoid the number of flow lines required if wells were widely spaced.

A subsea production system was installed in the Zakum field of Abu Dhabi Marine Areas Ltd. in the Arabian Gulf in 1970. The field is operated by British Petroleum and Cie. Francaise du Petroles. The system is electrically operated and diver maintained; the site is in 70 feet of water and was selected so as to be readily available for diver maintenance. The system includes all well controls, a gas-oil separator, and a gas driven generator for electrical power. The system is purely experimental, but is operating and indicates what may be possible in the future.

Exxon's submerged production system (SPS) has been proposed as a possiblity for the development of the Santa Ynez Unit in the Santa Barbara Channel and was discussed in the U.S. Geological Survey's environmental impact statement covering this subject. Exxon's submerged production system (SPS) which provides facility for 3 wells has successfully completed land tests. The SPS is a cluster of subsea wells and associated production controlling, separating and pumping equipment mounted on a subsea structure. The produced fluids are transported to surface processing facilities via pipelines to shore, to a platform or to a production riser connected to a floating vessel. The subsea equipment is remotely controlled and monitored from the surface facilities by an electro-hydraulic supervisory control system. Pump-down tools are used to service wellbore equipment and a manipulator operated from the surface is used to replace non-operative subsea equipment. All elements of the system have been designed and land tested. Work is in progress to perform an offshore test of the complete system.

The system essentially consists of a cluster of wells drilled through a seafloor template and connected through a manifold system. The manifold system is surrounded by a track on which a wellhead and manifold manipulator runs. The manipulator is controlled from the surface and can control all well control functions. Provision is also made for access to the annulus of each well. The manipulator maintenance system is shown in Figure 5.

The submerged production system (SPS) provides equipment and procedures which span the production requirements of a field from the time development drilling starts to field abandonment and from wellbore equipment at the completion interval to the processing equipment at the common carrier custody transfer point. The SPS is composed of eight functional subsystems as follows: 1) the drilling and completion subsystem, 2) the manifold subsystem, 3) the remote control subsystem, 4) the pump/separator subsystem, 5) the template subsystem, 6) the pipeline connection subsystem, 7) the production riser and floating facility subsystem and 8) the maintenance manipulator.

The final series of land tests on a prototype, 3- well, subsea production manifold and a maintenance manipulator were performed in a water-filled pit where the underwater production equipment was automatically operated to control well streams simulating liquid, gas-liquid, and sand laden production. In this testing, the prototype equipment met

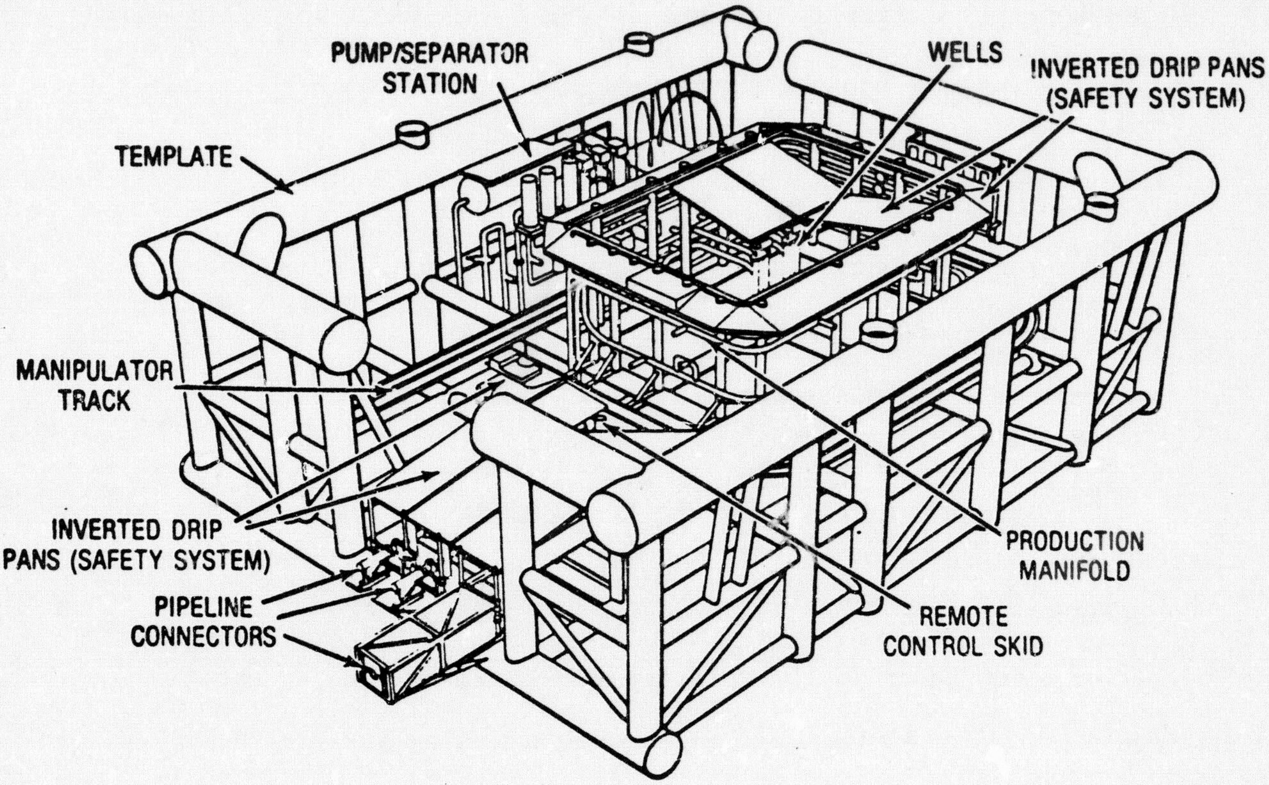

PUMP/SEPARATOR STATION
WELLS
INVERTED DRIP PANS (SAFETY SYSTEM)
TEMPLATE
MANIPULATOR TRACK
INVERTED DRIP PANS (SAFETY SYSTEM)
PIPELINE CONNECTORS
PRODUCTION MANIFOLD
REMOTE CONTROL SKID

Figure 5. EXXON SPS Manipulator System (Source: EXXON Company, U.S.A., 1971, Supplemental Plan of Operations, Santa Ynez Unit

or exceeded design specifications. In addition, the maintenance manipulator was deployed from a surface vessel to a mock-up installation in 425 feet of water to demonstrate its ability to land on its track which surrounds the underwater equipment. This development test, when coupled with the pit test, proved the manipulator to be capable of performing the maintenance tasks. Results of tests on the SPS wellbore equipment and on a pre-prototype pump/separator subsystem have indicated the utility of these equipment subsystem in performing their functions. Tests simulating operating conditions have permitted the design of prototype pipeline connecting equipment needed for the SPS.

An offshore test of the Exxon SPS is underway in the Gulf of Mexico off Louisiana. In this offshore test, installation, production and maintenance operations in the Gulf of Mexico will be performed in a manner representative of producing a deepwater field with an SPS and the full-scale depth-capable equipment will be used. The purpose of the test is to evaluate the cost and performance of the equipment and technique during installation, operation and maintenance activities. The results of extensive land testing indicate that the equipment will function properly and this offshore test will provide data necessary to evaluate both equipment and procedures.

The test includes a template with producing equipment placed on the sea floor in 170 feet of water in West Delta 73 Field which is 27 miles southeast from Grand Isle, Louisiana. Three wells in the test will deliver production to a manifold which surrounds the well bay, then to a subsea separator and fluid pumps. At that point, gas will flow via pipeline to the nearby "F" platform. Liquid will be pumped using submersible electrical pumps via an articulated production riser to producing facilities on the platform. The riser will be tested to confirm its capability although no oil will be loaded to a service ship in the pilot test. The test plan for the template calls for all work on the sea floor to be done remotely without the use of divers, simulating deep water application.

The template was fabricated and equipment installed and tested in McDermott's yard in Morgan City, Louisiana, over a period of 15 months beginning in May, 1973. The template was launched much like a conventional platform jacket on October 19, 1974. Subsequently, the unit keelhauled under a drill ship, the Glomar "GRAND BANKS", then lowered to the sea floor with the rig draw works. Four pilings have been drilled in and cemented to the floor and the template leveled. Pump caissons have been installed.

Five pipelines have been layed and connected to the template by remotely controlled operations. Two of these lines (1-3" ID pump down tool line and the 8" gas line) connect directly to the "F" platform. The other three lines (a 3" ID pump down tool line, 3" ID gas injection line and 8" oil line), also terminate at the "F" platform by way of the production riser. The two cables, a 35 kv cable supplying power to the fluid pumps and a 5 kv remote control cable, have been laid. As of November 1975, three wells had been drilled and the maintenance manipulator deployed to make planned connections on the sea floor equipment. Pipeline pumps have not yet been installed. Although there have been problems as would be expected in a test of this magnitude, no basic flaws have been detected in the SPS to date.

The test will have a minimum duration of three years but producing and maintenance operations will probable be continued until they can no longer be justified.

Shell Oil Company and Lockheed Petroleum Services joined efforts to develop and field test an ocean-floor system for completing and producing wells. The system is based on the concept of housing more-or-less standard equipment in one-atmosphere chambers. The chambers can then be linked together with subsea pipelines to form a complete producing system. Servicing the equipment inside the chambers can be performed by experienced oilfield workers, transported to and from the chambers in a dry, one-atmosphere diving capsule.

The current joint program consists of three phases. Phase I, the Lockheed Petroleum Services (LPS) one atmosphere system was completed and installed in 1972, for Shell Oil Company in the Gulf of Mexico (Main Pass Block 290) at a 375 foot water depth. There have been no major technical problems with the wellhead chamber and the well has produced over 1/2 million bbls. of oil.

Phase II, the subsea manifold center, has been installed in Eugene Island Block 331 Field. Work has been temporarily suspended until spring 1976 awaiting better weather conditions. The LPS wellhead cellar is supported on the casing head housing and is surrounded by the guide frame whose base is 2-5 feet above the sea floor. This is all supported by a 29-1/2" diameter drive pipe penetrating the sea floor. Foundation for the manifold center is a barge that carries the system to the site and is sunk to form the base on the sea floor. All LPS equipment and materials have been carefully selected for the appropriate pressure rating and subjected to extensive testing. Every well is equipped with automatic fail-close valves and remote shut-in controls actuated hydraulically from the platform.

A control panel on the platform regulates all the sensing and remote funtions and include:

1) Remote actuation and position control of ail remotely operated valves and chokes.
2) Pressure sensors in pipelines.
3) Sequential shut-in system
4) Testing of the emergency shut down system (ESD).

An ESD condition will sequentially close the manifold center's hull valves and subsea Christmas-tree's fail-safe valves (all master and wing valves simultaneously). The tubing removable surface controlled sub-surface safety valves (SCSSV) at Eugene Island is a ball type which was updated from the storm choke used in Main Pass to meet OCS Order No. 5.

All oil and gas pipelines will be equipped with automatic shut-in valves connected to ESD and remote shut-in systems. Hydraulic lines are equipped with back-up systems if the ESD fails.

The third phase will consist of a subsea clustered well system. It is anticipated that data from this system will provide the sound basis necessary to project design and cost criteria for application in up to 3,000 feet of water.

In September 1973, Shell, utilizing the atmospheric diving system of Lockheed Petroleum Services, Ltd., successfully re-entered and performed maintenance in a subsea wellhead chamber at atmospheric pressure in 375 feet of water in the Gulf of Mexico, offshore Louisiana. The primary purposes for the re-entry were to locate and repair a leak in the hydraulic control system, observe the condition of chamber and tree components after one year of operation, and provide diving experience for Shell personnel.

The chamber and internal components were found to be in excellent condition during the first dive. Nine dives were made and all work was completed as planned under ideal weather conditions during the seven day period.

In the first three years the well has produced 950,000 barrels of oil and 300 million cubic feet of gas and is currently producing at a rate of 950 barrels of oil per day and 700 thousand cubic feet of gas per day. Maintenance and remedial experience has included six TFL (through-the flowline) operations, where tools are pumped through the tubing, to service subsurface controls and acidize the lower zone, and three entires into the WHC (wellhead chamber) for routine maintenance.

Two examples of the Lockheed system for wellhead equipment are shown in Figure 6. The chambers shown are those permanently installed on the wellhead and the upper hatch indicates where the service capsule is attached.

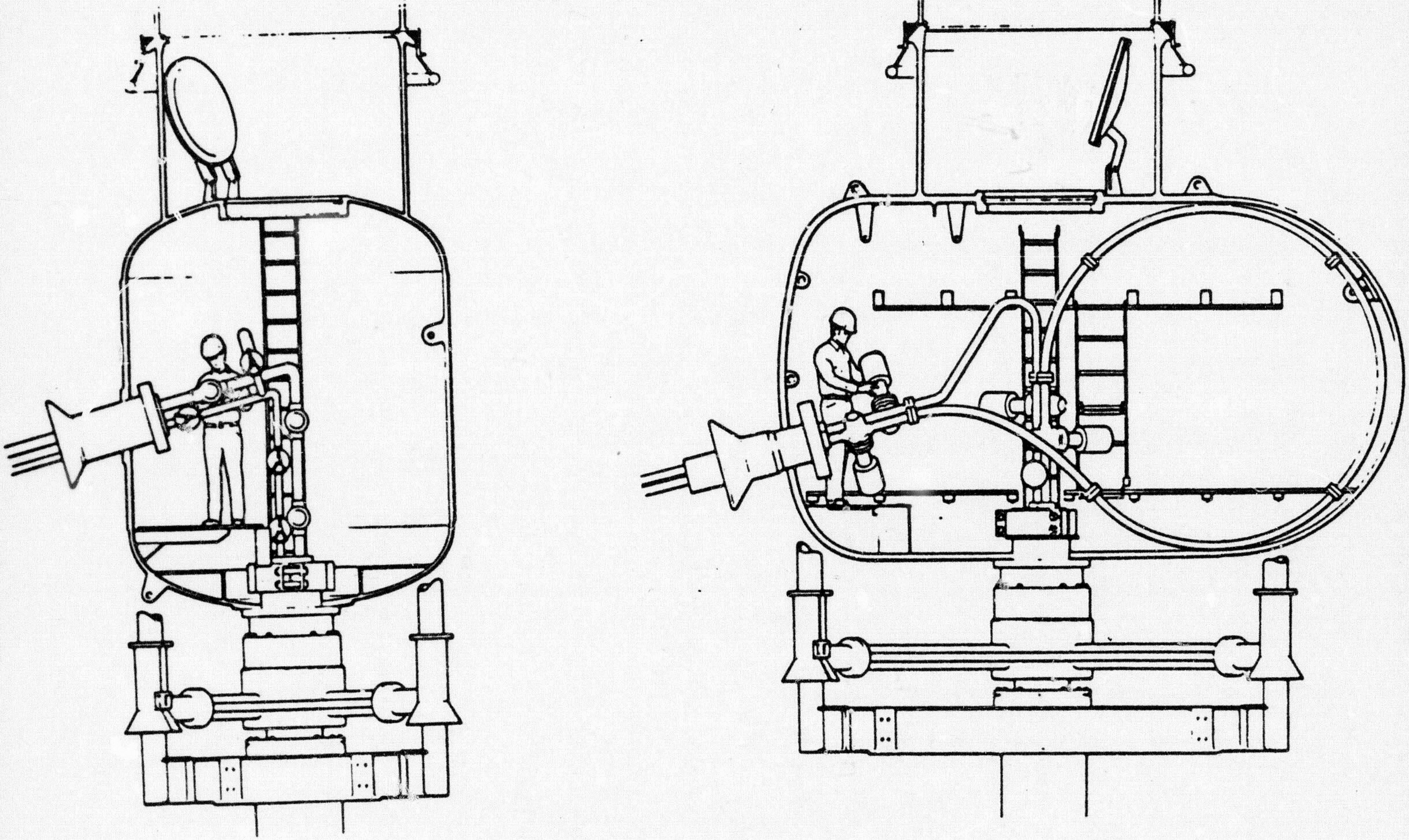


Figure 6. Lockheed One-Atmosphere Subsea Completion System

a. For Wellhead Installation Where TFL Tools are not required.

b. A Wellhead Cellar Designed to Enclose the TFL Tubing Loop.

(Source: Lockheed Petroleum Services, Ltd. (Also presented at the Sixth Annual Offshore Technology Conference, Houston, Texas, May 6-8, 1974)

After the capsule is connected, the chamber below the capsule and above the entry hatch to the work chamber, is pumped dry and the atmosphere is tested prior to opening the hatches.

Subsea Equipment Associates Limited (SEAL) has been principally funded by British Petroleum, Mobil Oil Company, Compagnie Francaise des Petroles, Westinghouse Electric Corporation, and Group Deep, the latter a consortium of European Contractors. Associate members of the group include Conoco, Sunoco, Phillips, ELF/ERAP, and Petrobras.

SEAL currently has under development three subsea oil and gas production systems. Two of the systems undergoing tests are designed for use in foreign fields where high production rates are prevalent. SEAL is also testing a subsea oil production system in the Gulf of Mexico which is designed primarily for utilization with large numbers of domestic low-production wells of less than 1,000 barrels per day which in turn generally require significant maintenance. Sun Oil Company is participating in the test project in the Gulf.

Essentially, the SEAL system is similar to the Shell-Lockheed system where working areas are enclosed in atmospheric chambers and access is available through personnel transfer capsules lowered from a surface vessel. Systems have been designed for individual well completions, cluster type well completions, a production manifold station, a subsea separation facility and a subsea pumping station.

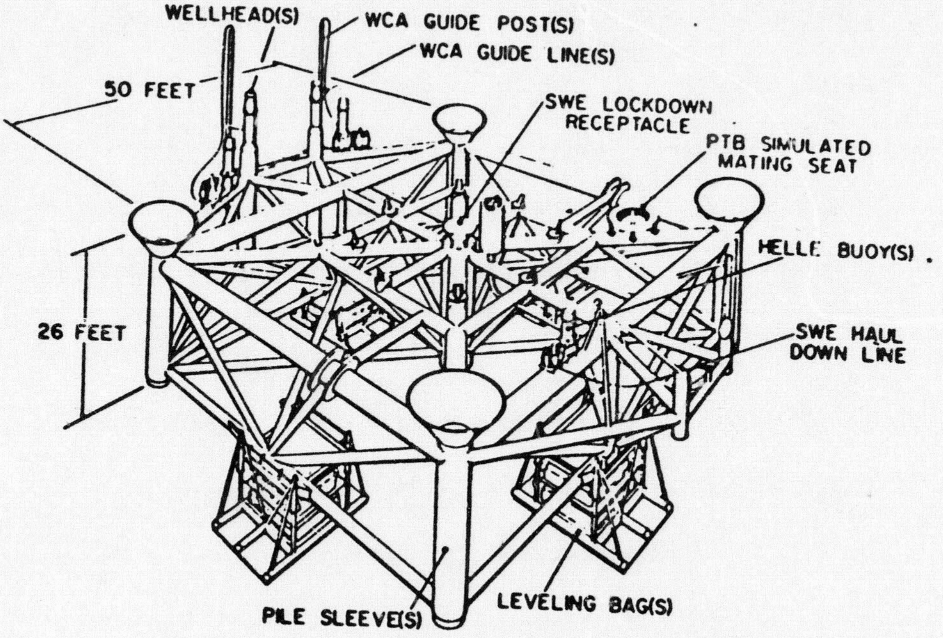
As in other similar systems a base plate is hydraulically connected to the wellhead. For a multiple well system the base serves as a drilling template for directionally drilled wells and part of the structural piping is used in the manifolding system for the wells. The subsea work enclosure is then connected to the base structure and has provisions for personnel entry through a hatch from a personnel transfer chamber. The configuration of the work chamber can be varied depending on the water depth, number of wells associated, production rates, etc. The chamber provides a dry working environment on the ocean floor at atmospheric perssure.

Phillips Petroleum Company is presently completing exploratory wells in the Ekofisk field in the North Sea in about 220 feet of water using this method. They are completing the well and connecting the base plate and lower master valve before releasing the drilling rig. The upper portion of the wellhead assembly(the work chamber and associated valves and piping) will be installed when production facilities are available. This installation can be made with a small support vessel without requiring the services of an expensive drilling vessel. Previously, exploratory wells were either abandoned, or temporarily abandoned. Abandonment represents a loss of considerable investment and if temporarily abandoned, a drilling vessel would be required to re-enter and complete the well.

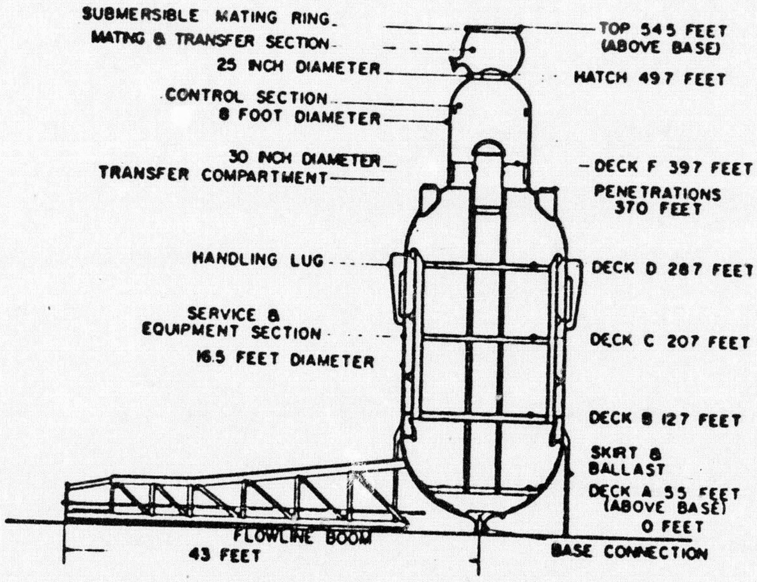
Another test of the SEAL system was made in the Gulf of Mexico. This involved a multi-well system and it is described in a paper titled "Subsea Manifold System" by Chatas and Richardson, Seal Petroleum Company. It is numbered OTC 1967 and was presented at the 1974 Offshore Technical Conference in Houston, Texas.

Testing started by simulating field production on dry land in 1971, in Long Beach, California, where the prototype was constructed. In 1972, the unit was transported to the Gulf of Mexico and installed in 247 feet of water 800 feet from a Sun Oil Company production platform at Main Pass 293A. First tests were conducted by diverting production from wells on the platform through the manifold system. After processing, the production was returned to the platform; additional drilling operations were started in December, 1973, and the test was completed in September, 1974.

During the commissioning and check-out phase of the test, 56 entries by personnel were made into the subsea work enclosure (SWE). Most of these personnel were not divers, but regular oil company personnel. Over 90 automatic operations of pump-down tools were performed, principally to remove paraffin deposits in the wells. These tools were pumped through the flow line network, to the platform, down the well and returned. The personnel transfer bell used in these tests is capable of transporting five men into the subsea structure. The base of the SEAL Atmospheric System (SAS) and the subsea work enclosure (SWE) used in the Gulf of Mexico test are shown on Figure 7.


WELLHEAD(S)
WCA GUIDE POST(S)
WCA GUIDE LINE(S)
50 FEET
SWE LOCKDOWN RECEPTACLE
PTB SIMULATED MATING SEAT
HELLE BUOY(S)
26 FEET
SWE HAUL DOWN LINE
PILE SLEEVE(S)
LEVELING BAG(S)

a. Base & wellhead connector assembly


SUBMERSIBLE MATING RING
MATING & TRANSFER SECTION
25 INCH DIAMETER
CONTROL SECTION
8 FOOT DIAMETER
30 INCH DIAMETER
TRANSFER COMPARTMENT
HANDLING LUG
SERVICE & EQUIPMENT SECTION
16.5 FEET DIAMETER
TOP 54.5 FEET (ABOVE BASE)
HATCH 49.7 FEET
DECK F 39.7 FEET
PENETRATIONS 37.0 FEET
DECK D 28.7 FEET
DECK C 20.7 FEET
DECK B 12.7 FEET
SKIRT & BALLAST
DECK A 5.5 FEET (ABOVE BASE)
0 FEET
BASE CONNECTION
FLOWLINE BOOM
43 FEET

b. Subsea work enclosure

Figure 7. Seal Subsea Manifold System (Source: Subsea Equipment Associates, Ltd. (Also presented at the Sixth Annual Offshore Technology Conference, Houston, Texas, May 6-8, 1974)

The SEAL Atmospheric System (SAS), which was tested in the Gulf of Mexico, was based on the use of a large habitat type structure permanently installed on the sea floor to house oil field equipment. The SAS system incorporates a subsea manifold system in which various oil field production equipment can be installed depending on the application.

The three major elements investigated in cojunction with the SAS Test Program were as follows: 1) the Subsea Work Enclosure (SWE), 2) the automatic production control system, and 3) automatic well maintenance system based on use of TFL (through-the-flowline) test.

A test separator located within the SWE was a vertical two-phase separator capable of handling produced volumes of approximately 400 bbl/day of oil and 760,900 scf of gas per day. Due to the characteristics of wells produced through the SWE during the tests, the separator was operated at full capacity and demonstrated repeatability of each well tested and correlated accurately with production data available on each well.

The separator instrumentation was of a conventional nature utilizing temperature, pressure, and differential pressure on a gas meter run, a net oil computer and a displacement meter to give quantity and percentages of oil and water.

A common approach in the SEAL systems has been the use of trained oil field personnel on the sea floor. The maintenance personnel are transported from the surface to the subsea structure in a Personnel Transfer Bell. Test operations have proven conclusively that the vehicles are efficient and can be operated safely.

Future applications of this concept would be as a manifold center, a test separator center or a complete oil production system. In a similar manner to the other systems, men are transported to and from the Subsea Work Enclosure (SWE) through the use of a Personnel Transfer Bell. The men perform their duties at atmospheric pressure.

Other submerged production systems are in the design or test stage. Deep Oil Technology, Inc., Transworld Drilling Company (a subsidiary of Kerr-McGee Corporation), and Standard Oil of California all have systems that have not yet been fully developed. The Transworld system is similar to the Lockheed and SEAL systems where an underwater work chamber at atmospheric pressure is utilized. The main difference is that wellheads would be maintained in a wet atmosphere except when work was actually in progress with the underwater work chamber in place. Construction is in progress on prototype models and the system is designed to be operable in water depths to at least 1,500 feet.

A possible production system where production from subsea wells is directed to a surface vessel containing separation equipment is more likely to be used in deep water where platform costs become prohibitive.

To meet the needs of producing large amounts of oil from deep water tracts with hard bottoms in the harsh physical environment of the North Sea, many petroleum companies have turned to the use of concrete platforms. These strucutres rest on the ocean bottom by virtue of the great weights--upwards of 300,000 tons or more. Each platform is completed onshore and then towed upright to the development site, where ballast tanks are flooded and the structure settles to the seafloor.

Figure 8 shows the designs of two North Sea platforms to be installed in about 500 feet of water. Each platform is similar in size and construction methods and will have storage cpapcities of 900,000 barrels of oil in the base.

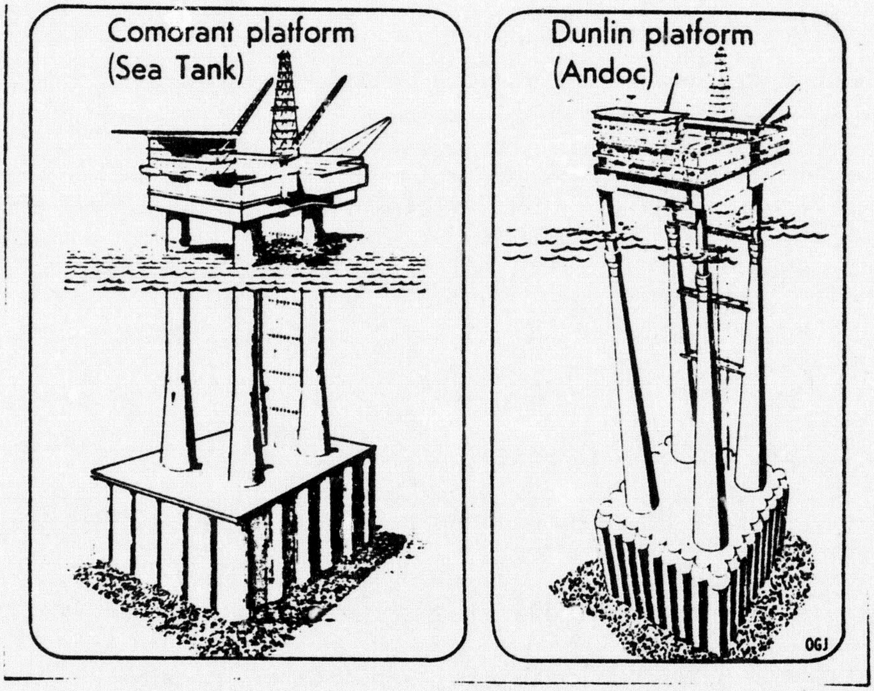


Figure 8. Gravity Type Steel and Concrete Combination Drilling, Production and Storage Platforms. (From Oil and Gas Journal, May 27, 1974, Vol. 72 (21):34).

A large concrete storage tank has been in place in the North Sea field since 1973. This structure is 305 ft (93m) in diameter and 295 ft (90 m) high and has a capacity of 1,000,000 barrels of oil.

Sea floor requirements of all these structures include (1) an even bottom, (2) strong bearing capacity of surficial and underlying sediments, (3) little lateral variability of these same sediments. A discussion of potential impacts to these structures from sediment failures can be found in Section III.B.3.

Because of the size of anticipated finds, expected production, production by pipeline, and availability of steel fabrication yards; it is not anticipated that concrete gravity structures will be used as a result of this proposed sale.

The waters associated with oil and gas reservoirs and which are frequently produced along with the oil and gas are called formation waters. It is highly unlikely that any of the produced formation water resulting from this proposed sale would ever be piped ashore. Both economic and environmental considerations weight heavily towards choosing to treat and release the water into the ocean at the platform site or reinject it into subsurface formations. Reinjection is utilized where feasible as a secondary recovery technique by pumping formation water, under pressure, back into the lower levels of the petroleum-producing zone and thus maintaining good reservoir pressure. Disposal of formation water into other than the producing formation is not done because of the expense involved. This method of disposal requires a separate well plus some water treatment to insure that the injected water is compatible with the host reservoir. Formation water which is to be discharged into the ocean is first passed through a water-treating facility that removes all but traces of entrained oil. However, the water is still void of dissolved oxygen and contains large quantities of dissolved minerals, but in any case must meet EPA standards.

Since petroleum production involves the handling of flammable fluids under pressure, the safety systems control is of utmost importance to preclude hazardous conditions. Nowhere is this hazard greater than during workover, or remedial operations on a well in order to improve its production rate or to replace faulty downhole equipment. Since workover operations are potentially hazardous, they must be planned carefully, both to keep wells from getting out of control and to prevent or minimize the release of oil to the environment. Currently under review within the U.S. Geological Survey is a proposal to revise OCS Operating Orders to reduce or prohibit simultaneous production and drilling from the same platform. The restrictions would apply to workover operations as well as to drilling and production operations.

To reduce pollution, specially treated salt water that can be weighted with various materials is used for hydrostatic control when re-entering the wells in wire-line or swabbing operations.

To increase production, acid or other fluids and suspended particulate matter may be pumped through the well bore into producing formations. The function of this treatment is to enlarge flow channels leading to the well. The spent acid returns up the well when production is resumed, and is handled as are other fluids from the well. Oil and water contaminated with spent acid are transported with the rest of the production to the refinery.

Sand produced along with the well fluids can cause the wells to plug, or "sand-up", periodically and must be removed. Other procedures to increase productivity and oil recovery include the injection of high-pressure steam, water, and/or gas into specially prepared injection wells. The water used for this purpose may be taken from the ocean or from formation water. Water too contaminated to be treated and discharged is either reinjected into formations or transported ashore for further treatment and disposal. Suitable precautions are taken to ensure that fresh water aquifers will not be contaminated by oil or salt water. Gas produced from the well may be reinjected for pressure maintenance where feasible or piped to shore for sale.

From the safety standpoint, completion and workover operations must be conducted carefully, and it is their critical nature that, in all likelihood, makes these operations safer than they otherwise might be. Operators of swabbing and wire-line units are well aware of the hazardous nature of their work and are extremely cautious. Despite the potential hazard, safety records during wire-line and swabbing unit work are excellent.

Offshore pipelines, particularly large diameter or long lines, are usually installed using a barge specially constructed for marine pipelining called a "lay barge". This barge is a self-contained unit including all of the facilities required to join the pipe by welding, cover the weld with protective coating, and to lower the pipe into place on the ocean floor. The pipe is coated on shore and delivered to the lay barge in uniform lengths or "joints" with the ends prepared for welding. Several anchors, at least two at each corner, are used to hold the barge in position. Joints of pipe are welded together on the deck of the lay barge to form a continuous length. When a weld is finished, inspected and coated, the barge is moved forward allowing the assembled pipeline to extend over the stern of the barge and to sag downward to lay on the ocean floor. A new length of pipe is added to the "forward" end of the pipeline and the process is repeated. Making a high-quality pipeline weld requires a reasonable amount of time. Therefore to obtain rapid production, "assembly line" techniques are used allowing welding to take place at several stations simultaneously. To do this the work on the barge must take place in an almost level position. From the barge to the ocean floor the pipe will assume a double curve or "S" shape. If the pipe is too stiff to reach the bottom unsupported, a buoyant pontoon or slide called a "Stinger" is used to provide support for the upper section of the pipeline. To help support the weight of the pipe and to prevent buckling, a carefully controlled tension force is applied to the pipe by constant tension machines mounted on the barge.

The pipe assembly process utilizes the latest technology and the best welding techniques currently available. All joints are given a complete X-ray inspection for quality and then covered with corrosion resistant material prior to leaving the barge. Offshore pipelines are designed and installed to meet the same codes and specifications as onshore pipelines, such as API, ANSI, ASME, etc. After the line is completed, it is tested to make sure that it has been properly installed and will withstand the anticipated operating pressures safely. The pipe is further protected by cathodic protection systems to supplement the corrosion resistant coating.

The technology now exists to lay large diameter pipelines in depths of 1,000 feet or more in harsh environments. For example, the semisubmersible pipelay/derrick barge Semac I, presently under construction in Mobile, will be capable of laying large diameter pipe in up to 1,000 feet of water in sea conditions encountered in the northern North Sea. With additional equipment the unit will be capable of laying pipeline in even deeper water (USGS, Written Comments, DES Proposed OCS Lease Sale #40, 1976).

Burial is effected by jetting sediment away from underneath the pipeline and allowing it to sink into the resulting trench. The equipment used in this operation consists of a work barge equipped with high volume/high pressure water pumps and air compressors. From the barge, a multiple membered towline consisting of a strength member, water line, and air line extends downward to a U-shaped structure which straddles the pipelines and glides along it on rollers. Affixed to the U-shaped jetting device are several nozzles which direct water and air, under high pressure, ahead and below the pipeline. Sediments are blasted out of narrow trench by the water jets, partially lifted by the air and deflected to the sides by various types of fins. The suspended sediments fall diffusely along either side of the trench. As the jetting device is pulled forward, the pipeline settles into the trench and is partially buried quite soon by the reworked sediment as it slips and settles back in to the depression. Complete burial and restoration of original bottom contours may require additional time. In shallow waters, experience has shown contour restoration to be quite rapid, whereas in deeper waters, more than a year may be required.

Even though a buried line is protected from fluid forces it is not necessarily stable. If it is too light, it will gradually work its way up through the soil and become exposed to the water forces. If it is too heavy, it will gradually sink in the soil and impose additional tensile stress in the line. Design procedures for determining the vertical stability of the line in sands and clays have been developed and are available in the industry.

Difficulties have been experienced in burying pipe in cohensionless sands. In this case the sand will often refill the jetted trench before the pipe can settle into it. Another method, fluidization of the sand, enables successful burial in this type of substrate.

To prevent corrosion, pipelines are carefully coated with such material as epoxy compounds or thick asphaltic mastic. If extra weight or mechanical protection(from fisheries trawling for example) is needed, these, in turn, are covered with a layer of dense concrete. The lines are protected from electrolysis by both impressed-current systems and by sacrificial anodes (zinc is commonly used). Corrosion prevention measures are now required by 49 CFR Part 195. Although offshore pipelines are relatively inaccesible as compared to onshore pipelines, they nonetheless can be repaired by divers. Methods of using submersibles to latch on to a subsea line and repair it with mechanical arms and special tools are under study and nearing the point of practical demonstration.

As in the case of workover operations, the expense of the pipeline installations, coupled with the catastrophic implications for the local marine environment should a major break occur, have combined to dictate a highly conservation design, emplacement, and operating philosophy.

As the pipeline construction approaches and traverses the shoreline, it is buried deep enought to avoid its being exposed by storm-associated beach erosion.

Onshore, the pipelaying method depends upon the type of terrain transgressed. If a pipeline were to be allowed to cross wetlands in which there was no firm ground to support equipment, a canal 40 to 50 feet wide would be needed. Lay barges are usually utilized in such areas. The dredged material would be placed alongside the canal and form a low, flat levee. With required openings and bulking (plugging the ends), erosion and salt water intrusion would be minimized, as would disruption of drainage patterns; although these problems may still persist to some degree. In firmer wetland areas, a smaller canal, about 10 feet wide would be dredged and backfilled. On firm land, the routine trench and backfill method is used which is the same technique by which water and sewer lines, cables, and so forth are buried.

A rough estimate of the width of land disturbed by pipelines laid through wetlands or on land would be 50 to 60 feet disturbed by equipment and a band of perhaps 30 to 40 feet of soil and vegetation removed. On land, a swath of perhaps 50 feet would need to be maintained free of trees and large shrubs to permit maintenance vehicle access and surveillance for leakage.

The safe operation and maintenance of a pipeline system requires several redundant monitoring systems to ensure the integrity of the line and detect leaks. The primary leak detection system in use (required on all lines built after March 13, 1970 by 49 CFR Part 195.406 and 195.408) is a set of automatic pressure sensing recorders on both ends of each pipeline system. These devices are equipped to either shut down the flow automatically or sound an alarm to alert personnel of an abnormal pressure level. In this way, a leak of substantial rate is detected immediately. This system is insensitive to leaks which do not produce a decrease in line pressure greater than 300-500 psi. It is essentially a safeguard to prevent the escape of large volumes of oil due to a catastrophic line break.

The second system of leak detection is the routine patrolling of the offshore wetlands routes by boat or aircraft, and onshore by wheeled vehicle or aircraft. A minimum patrolling frequency, with intervals between inspections not exceeding 2 weeks, is required by 49 CFR Part 195.412, but in actual practice is performed more often. This type of monitoring would result in the detection of all sizes of leaks of course, but would be of little consequence in preventing the loss of a large amount of petroleum in the event a large line were severed. The appeal of a system of regular pipeline patrolling is that it allows detection of small leaks and therefore complements the pressure-sensing system described above. With volume of airborne and waterborne traffic expected over the potential oil producing area of the Mid-Atlantic, it is considered highly improbably that any spill would go undetected for any appreciable length of time.

The third system for leak detection consists of a series of volume-recording flow meters on either end of a pipeline system. Because nearly all crude oil moves from OCS areas to shore by common carrier lines, it must be metered in the offshore pipeline gathering system and again at the onshore pipeline terminal in order that each producer be properly credited for his share of the common stream. The flow sensors continually measure input and output in real time; thus when attendant personnel record these readings for inventory control they are able to discover a decrease in output which would indicate the possibility of a leak. This is usually done on a shift schedule, once every eight hours or more frequently.

One more safety feature which would be built into all pipelines resulting from this proposal, according to industry spokesmen, is that remotely operated mainline block valves will be provided at remotely controlled pipeline facilities in order to allow isolation of segments of the pipeline. Isolating valves are required by CFR 195.260 and remote operation of these valves, while voluntary, would be one of the primary objectives of a remote controlled pipeline facility. Table A shows the relationship between the diameter of a pipeline and the volume contained per mile of line.

Table A. Length/Volume Relationship of Linepipe

Size (inches ID)	Length Required to Hold 1000 bbl. (miles)	Barrels Per Mile of Line
2.067	45.6	22
4.026	12.0	83
6.026	5.3	189
8.071	3.0	334
10.020	1.9	515
12.090	1.3	750
24.000	0.3	2954

Surveillance of pipelines can be performed by a variety of means. Side-scan sonar can be used to locate the pipeline and determine if it is buried. Underwater TV cameras can be extended from a vessel to examine the pipeline without using more expensive means. Divers can go down to actually inspect the line, burial depth, an condition of coatings. Miniature submarines can perform the same tasks with the added advantage of shirt sleeve environment, longer underwater duration, radio contact with the surface, and close examination of seafloor conditions by trained technicians. Measurements of catholic-protection of the pipelines can be taken by divers and from manned submarines.

APPENDIX 5

MEMORANDUM FROM MOBIL OIL CANADA, LTD.

TO

EXXON COMPANY, U.S.A.

Mobil Oil Canada, Ltd.

BOX 800
CALGARY, ALBERTA
T2P 2J7
TELEPHONE (403) 268-7910

A. R. NIELSEN
PRESIDENT AND GENERAL MANAGER

May 8, 1975

Exxon Company, U.S.A.
P. O. Box 2180
HOUSTON, Texas 77001
U.S.A.

ATTENTION: Mr. J. R. Jackson, Jr.

Dear Sir:

Further to your letter of April 28, 1975 we are supplying information on the oil found in the Sable Island discovery well, Mobil Tetco Sable Island E-48. This well was drilled in 1971 on the west tip of Sable Island (43°57'20.5" N. Lat. 60°07'23.9" W. Long.) and discovered oil within the intervals of 4750-5373 and 5524-7775 feet K.B. The samples from these intervals have the following properties:

Interval, ft KB	Oil Gravity, $^{\circ}$API	Sulphur wt%	Pour Point, $^{\circ}$F	Viscosity, SUS @60°F
4750-5373	35-41	0.02-0.032	<-65 to +30	33-36
5524-7775	50-58	0.005-0.007	-20 to -5	29-30

We also have attached a copy of an article from the January 21, 1974 issue of Oilweek. This article summarizes a talk by Mobil's Mr. H. Smith detailing the results of the first three wells drilled on the West Sable Structure. It is hoped you will find it of interest.

Yours very truly,

a R Nielsen

A. R. Nielsen

Sable Island E-48 discovery well had best pay of nine island tests

Eastcoast exploration knowledge got a boost when details of the first three wells on the West Sable structure were bared to the Canadian Society of Petroleum Geologists by Harvey Smith of Mobil Oil Canada, Ltd., prior to the wells coming off the confidential list this year.

Pay zone details and geological data rounded out the presentation to a packed meeting in Calgary, leaving many latecomers with standing room only.

Smith detailed three out of eight wells drilled by Mobil and partner, Texas Eastern Exploration of Canada Ltd. on the western tip of Sable Island. The wells were the discovery wildcat E-48 drilled to 11,820 feet with data to be released by government later this month, the eastern appraisal test, O-47, drilled to 13,775 feet to be released in July, and the first of the directional holes on the H-58 platform which appraised the western portion of the West Sable structure and was drilled to a measured depth of 9,971 feet. Data on 1H-58 are due for release in August.

The other five directional holes drilled from the H-58 platform are scheduled to come off the confidential list in future, the final test 6H-58 was completed late last year as abandoned, while the other four are listed as suspended oil wells.

Smith revealed the West Sable structure is a domal feature, productive from several zones in the crestal position, but the major reservoir was found in the Logan Canyon formation comprising fine-grained sandstones deposited under very shallow water conditions ranging from supralittoral to littoral. He suggested two major periods of diapiric growth and the late growth period segmented the West Sable structure into a complex mass of fault blocks.

The regional geology consists of Tertiary, Cretaceous and Jurassic sediments overlying a pre-Carboniferous basement and comprising the Sable basin. The Tertiary and Cretaceous primarily consist of a seaward thickening wedge of sandstones and shales reaching a maximum thickness of 15,000 feet. The Jurassic sediments of evaporite deposition and marine transgressions were trapped in grabens at the continental margin, resulting from rifts in late Triassic to early Jurassic times.

Normal faulting and many salt diapirs characterize the basin and the West Sable structure was described by Smith as "a diapiric feature located some six miles south of a major fault . . . (which) marks the approximate northern boundary of the Sable basin."

Of the eight wells drilled around this salt dome, six were located within a one mile radius from the E-48 discovery.

Sable Island box score

The box score on the three wells, released by Harvey Smith on behalf of Mobil Oil and Texas Eastern Exploration, prior to official release dates, is as follows:

Sable Island E-48 had total hydrocarbon pay of 811 net feet. Pay zones range in thickness from two to 32 feet. Pay extends over interval from 4,430 feet to 7,775 feet for a total of 3,345 feet. Water bearing sandstone interspace productive sections.

Sable Island 1H-58 had an estimated net pay of 113 feet. Zones range from two to 20 feet over interval from 4,363 to 5,800 feet, a total of 1,437 feet.

Sable Island O-47 had a net gas pay of 64 feet at 12,440 feet.

Pays occurred in Dawson Canyon and Upper Logan sandstones at 1H-58 and E-48; in Lower Logan Canyon sandstones at E-48 and in Verrill Canyon sandstones at O-47.

Pay zones equivalent to those found in the E-48 discovery well, were not found at O-47, located 4,200 feet to the southeast, and were significantly thinner or absent at 1H-58 located 2,500 feet to the northwest.

Maximum test results for individual zones in the E-48 well were 2,880 b/d 36° API oil, and 10.5 mmcf/d gas with 500 b/d 52-61° condensates.

The directional 4H-58 was just outside the radius. Smith said all the appraisal wells — including the five still confidential — have much thinner net pays than the E-48 well. The H-58 platform was 1,200 feet northwest of E-48 and the O-47 gas well was 4,200 feet southeast of the discovery well. The first directional well, 1H-58, bottomed out 4,800 feet northwest of E-48.

Smith showed slides detailing stratigraphy of E-48 and O-47 wells compared to the older C-67 well, located 10 miles to the east of E-48. Other diagrams gave pay zone details of 1H-58, E-48 and O-47 wells, but neither has yet been released for publication. Most of the information, however, can be detailed in summary:

The oldest strata penetrated was Argo Salt of Jurassic age. E-48 went into this salt shortly before reaching 10,000 feet and O-47 dipped into Argo salt around 13,000 feet.

Verrill Canyon formation of Lower Cretaceous and Jurassic age yielded gas with shows ranging from good to excellent in O-47 at 12,440 feet. Smith said formation thickness in this well was 2,277 feet and consisted of medium brown to grey shales with sandstones near the base of the interval. In C-67, shows ranged from trace to good at around 14,000 feet. Salt dome penetrated Verrill Canyon at E-48 well.

Net pay at O-47 in this formation was 64 feet. The gas bearing sandstones averaged 15% porosity and 41% water saturation. Best production tests occurred toward base of zone with 9.2 mmcf/d gas and small amounts of condensate. Pay zone above tested at 700 mcf/d and thinner zones, between 11,000 to 11,800 feet, had tests ranging from 15 to 250 mcf/d.

The Mississauga formation from the Lower Cretaceous period, occurred after 8,000 feet in both E-48 and O-47, and between 9,000 and 10,000 feet at C-67. Smith said the formation was 1,530 feet thick at E-48 and 2,140 feet thick at O-47. It consisted of sandstones, shales and limestones with grains from very coarse to very fine. Gas shows from trace to good occurred at the C-67 well only.

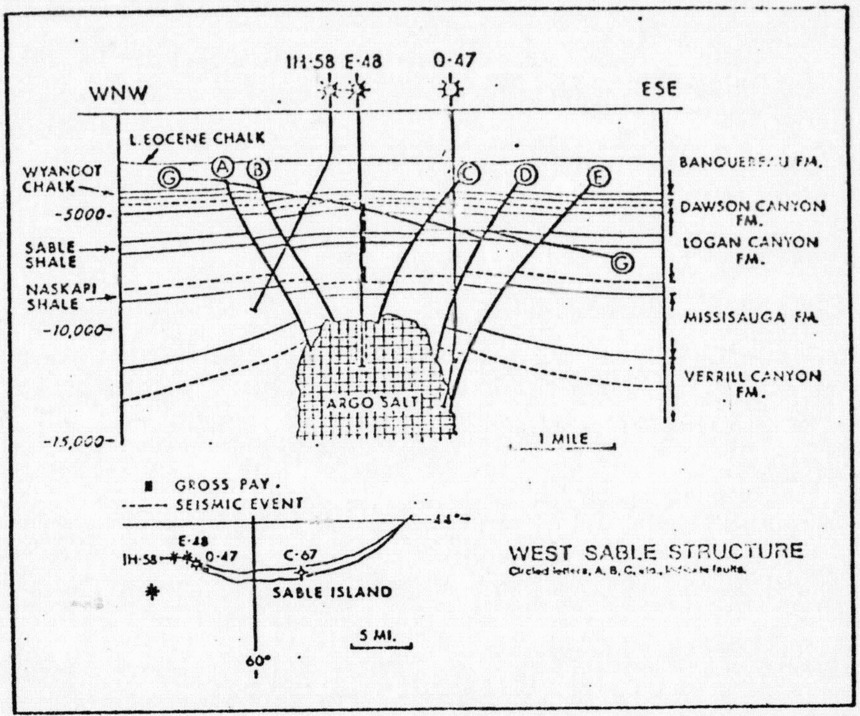
The thin Naskapi formation met shortly before 8,000 feet at both E-48 and O-47 and at around 9,000 feet at C-67 gradually thinned westward from 400 foot thickness at O-47. It consisted of medium to dark grey shale with very fine grained silty sandstones. Smith speculated it represented a tongue of Verrill Canyon shale.

The Logan Canyon formation was the oil and gas rich pay zone in E-48. Of Upper and Lower Cretaceous age, it

BEST COPY AVAILABLE

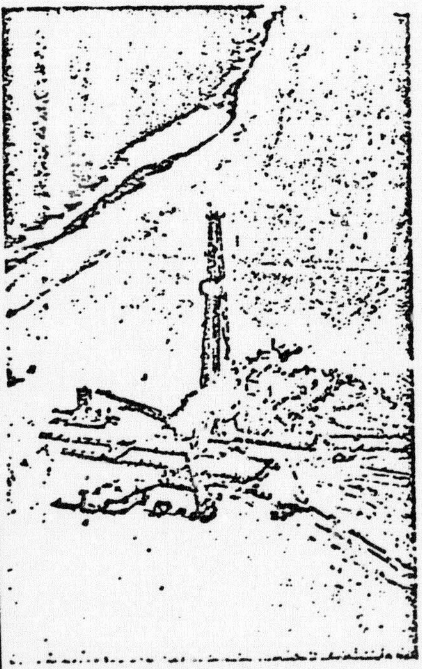
The lower Logan formation was 2,100 feet thick at O-47, said Smith, and appeared to be of similar thickness at E-48, but only about 1,500 feet thick at 1H-58. Sand percentage was rated at 47% to 50% with individual sandstone beds ranging from less than 10 feet up to 100 feet, but with most of the beds in the five to 30 foot range. Most common grain size is fine to very fine. Only traces of hydrocarbon shows were found in this formation in O-47 and C-67. No traces were indicated at 1H-58, where the zone is calculated to be water bearing. At E-48, however, Mobil found a total of 456 feet of gas/condensates. Porosities in the pay sands range from 17% to 24% and water saturation from 22% to 43%. The 11 production tests carried out ranged from 1.4 mmcf/d with 132 b/d to 10.5 mmcf/d with 500 b/d. Condensate gravity was 52° to 61° API.

The Sable Shale unit containing thin sandstone beds was indicated as a gas/condensate zone in E-48 but reservoir studies of drillstem samples could suggest a possibility of an oil reservoir. A net pay of 30 feet at E-48 compared to an indicated six feet of pay in 1H-58. Porosities averaged 22%, with water saturations up to 58%. The zone was not production tested, but a drillstem test at E-48 gave 4.5 mmcf/d, with 1,450 feet of 60° condensate.



Geological section illustrating major elements of West Sable structure is based on seismic reflections. Major faults define central graben over salt dome.

The upper Logan Canyon formation, which Smith said ranged in thickness from 760 feet at O-47 to 980 feet at 1H-58, also consisted of sandstone beds varying from less than five to almost 50 feet, but mainly 10 feet thick with very fine grains. The formation had three pay zones: dry gas zone with 80 feet of pay at E-48 and 40 feet at 1H-58. Porosities of 21% to 29% and water saturations of 27% to 29% were estimated. Production tests gave from four to 5.5 mmcf/d at E-48, and drillstem tests at 1H-58 yielded 5.3 mmcf/d.



Sable Island E-48 discovery well.

The first Logan Canyon oil zone followed the dry gas with 45 feet of pay at E-48 and 12 feet of pay at 1H-58. Porosity averaged 28% with 24% to 33% water saturation. E-48 production tests ranged from 390 b/d to 2,880 b/d of 36° API oil. Gas at 1.3 mmcf/d was produced with the higher rate. A similar test at 1H-58 yielded 7.3 mmcf/d with 228 b/d of 36° API oil and 16 b/d water.

The second oil zone consisted of 174 feet of net oil pay at E-48, while the 1H-58 equivalent sands were found water bearing. Porosities in the oil bearing sands were 23%, with water saturations averaging 44%, and E-48 production tests gave results ranging from 370 to 515 b/d of 36° to 41° API oil.

The Dawson Canyon formation, also of Upper Cretaceous age, was 590 feet thick at E-48 and 735 feet thick at O-47. It occurred at around 3,800 feet in the diagrams of both E-48 and O-47. The very fine grained sandstone, 200 to 500 feet above formation base, were productive at the E-48 and 1H-58 wells. The dry gas zone had net pays of 26 feet at E-48 and 55 feet at 1H-58. Smith said the thinner pay at E-48 was due to faulting. Porosities were 24% to 28% and water saturations 15% to 30%. Production test gave 2.4 mmcf/d at E-48. No test results were offered for 1H-58.

The Wyandot formation, a white chalky limestone about 260 feet thick, yielded gas at E-48 but at a rate too small to measure, said Smith. The Banquereau formation of Tertiary and Upper Cretaceous age was around 3,100 feet thick with chalky limestones and coarse sands dominating the formation, but no shows were encountered.

A thorough discussion on the formation of salt domes rounded out the Smith paper which was rated by many of the members among the finest given to the CSPG and in caliber and timing equal to earlier classics such as the Rainbow/Keg River paper and the Imperial Atkinson paper, both of which detailed well data prior to coming off confidential lists.

APPENDIX 6

SOIL LIMITATIONS

Visual 3 portrays soil limitions (defined below) for foundations onshore and shallow excavations occurring at depths down to 1.5 m (5 feet) in the Mid-Atlantic region. Information obtained from the Soil Conservation Service (1970a, 1970b) was used to plot the locations of various soil subgroupings. In turn, each soil unit was assigned a general value for limitations. In cases where a soil may have different limitations for different uses, the range was shown (for example, slight-to-moderate). In cases where a map unit contained component soils having varying limitations for a use, that range was also shown. This visual was prepared for future planning guidence.

Soil Limitations

Soil Limitations ratings of slight, moderate, and severe are given for use for foundations and shallow excavations. Foundations are for houses with basements and other buildings with similar foundation requirements. Shallow excavations, to an assumed depth of 5 feet, pertain to the several uses that involve the excavating of such as basements, trenches for pipelines or cuts for roads. Ratings for uses are based on the hazards, risks or restrictions of a soil as it occurs in the landscape or as it is normally modified by the use itself. They are defined in the paragraphs that follow.

Slight Limitations

These kinds of soil have properties that are favorable for the rated use and do not have soil features that are difficult or expensive to correct. These soils can be used successfully for the use being rated. Soil problems are minor and can be easily overcome. Good performance and low maintenance are common attributes of these kinds of soil.

Moderate limitations

These kinds of soil can be used successfully for the rated use but careful planning and design are required to overcome specific soil limitations or special maintenance may be required. There may be situations where the soil restricts somewhat the performance of the project. During some periods of time the performance of the structure or other planned use, although generally satisfactory, may be somewhat less desirable than for soils rated as having a slight soil limitation. Some soils with this rating may require special features in design such as soil drainage, runoff control to reduce erosion, extra excavation, or the modification of certain soil features through soil manipulation. Construction plans may need to be modified from those normally used to overcome soil limitations. This may include special foundations, extra reinforcements, sump pumps, and the like.

Severe limitations

Normally these kinds of soil cannot be used for the rated use except at great cost or risk because they have one or more adverse features. Some kinds of soil having a severe soil rating can be changed by reducing or removing the soil feature that limits its use. In some instances drastic changes in building plans are required. This is costly and many users find it unprofitable to alter the soil or modify the specifications for construction to this extent. Some kinds of soil rated as severe can be changed or the design criteria modified so these soils can be used successfully for the intended use. Normally it is better to select a soil that is less expensive to develop than one rated as having a severe soil limitation.

Slight to moderate, moderate to severe, slight to moderate (severe depending on location).

Soils whose intermediate rating depends on 1) the fact that a soil may have more than one rating for a given use, 2) a soil may have a rating for one use and another rating for a second use, 3) a map unit may contain more than one soil, each varying in limitations for a specific use.

APPENDIX 7

SUMMARY OF U.S. COAST GUARD REGULATIONS CONCERNING OFFSHORE STRUCTURES AS HAZARDS TO NAVIGATION

The pertinent regulations summarized below are found in the Code of Federal Regulations, No. 33, Navigation and Navigable Waters, Subpart 67.

The varied depths of water and marine commerce traffic routes which exist in the waters over the Outer Continental Shelf, and in other waters, permit the classification of structures according to their location in such waters. The structures in the area seaward of the line of demarcation specified by the Commandant and published in the Federal Register are designated as Class "A." This designation includes OCS platforms.

General requirements for lights specify that where structures have a horizontal dimension of over 50 feet on any one side or in diameter, an obstruction light shall be required on each corner or 90 degrees apart in the case of circular structures. Each light is to have a 360 degree lens. Where two or more obstruction lights are required by the size of the structure they must be in the same horizontal plane and not less than 20 feet above mean high water.

They shall be installed in a manner that will permit a mariner to hold sight of at least one of them until he is within 50 feet of the structure. Class "A" structure lights shall be white, powered from a reliable power source, and display a quick flash characteristic of approximately 60 flashes per minute. The lights shall be of sufficient candlepower to be visible at a distance of 5 nautical miles 90 percent of the nights of the year, and they shall be displayed at all times between sunset and sunrise local time, commencing at the time construction of the structure is begun.

The fog signal shall have a frequency range above 100 cycles and a loudness level of 55 phons and shall be sounded every 20 seconds (sound two seconds, silent 18 seconds). For Class "A" structures this signal shall have an audible range of not less than two miles (under no wind condition) in all directions from the structure it marks, whenever visibility is less than five miles in any direction.

Changes in these rules may be permitted upon approval of the District Commander when warranted by circumstances, such as proximity of structures.

APPENDIX 8

TRAFFIC SEPARATION SCHEMES:

NEW YORK AND NEW JERSEY HARBOR[1]

DELAWARE BAY[2]

CHESAPEAKE BAY[2]

---

[1] National Ocean Survey. 1975. United States Coast Pilot 2. Atlantic Coast, Cape Code to Sandy Hook. Washington, D.C.

[2] National Ocean Survey. 1974. United States Coast Pilot 3. Atlantic Coast, Sandy Hook to Cape Henry. Washington, D.C.

New York and New Jersey Harbor

A Traffic Separation Scheme has been established off the entrance to New York Harbor. The Scheme is composed basically of directed traffic areas each with one way inbound and outbound traffic lanes separated by defined separation zones, a precautionary area, and a pilot boat cruising area. The Scheme is recommended for use by vessels approaching or departing New York Harbor, but is not necessarily intended for tugs, tows, or other small vessels that traditionally operate outside of the usual steamer lanes or close inshore. The Traffic Separation Scheme has been designed to aid in the prevention of collisions at the approaches to major harbors, but is not intended in any way to supersede or alter the applicable rules of the road. Separation zones are intended to separate inbound and outbound traffic lanes. They are to be free of ship traffic and should not be used except for crossing purposes. Mariners should use exteme caution when crossing traffic lanes and separation zones.

The precautionary area off the entrance to New York Harbor is inscribed by part of a circle with a radius of 7 miles centered on Ambrose Light (40°27.5'N., 73°49.9'W.) and extending from off the entrance to East Rockaway Inlet to the shore southward of Sandy Hook with the traffic lanes fanning out from its periphery. A Danger Area is in the southeast quadrant of the precautionary area. Extreme caution must be exercised in navigating within the area inasmuch as both incoming and outgoing vessels use the area in making the transition between New York Harbor and the traffic lanes. The pilot boat cruising area is west of Ambrose Light

Eastern Directed Traffic Area

Nantucket to Ambrose Traffic Lane, Inbound

The eastward approach to New York Harbor is northward of Nantucket Shoals Lightship (40°30.0'N., 60°28.0'W.) through the Nantucket Ambrose Traffic Lane that tapers from 5 miles to 1 mile wide in its 193-mile length. By entering the traffic lane 4 miles north of Nantucket Shoals Lightship, a course of 268½° follows the center line of the traffic lane to a point about 4 miles abeam of Nantucket Traffic Lane Lighted Whistle Buoy NB (40°25.7'N., 73°11.5'W.), thence a centerline course of 265° to the junction with the precautionary area, and thence on a westerly course for about 8 miles to the pilot boat cruising area. The known, least depth in the traffic lane is 59 feet. Note: Nantucket Shoals Outer Lighted Gong Buoy 12 (40°44.3'N.,69°19.2'W.), about 15.9 miles north-northeastward of Nantucket Shoals Lightship, is established to facilitate the passage of westbound traffic north of the lightship.

Ambrose to Nantucket Traffic Lane, Outbound

The eastward exit by outbound vessels is south of Nantucket Lane Lighted Whistle Buoy NC (40°26.5'N., 73°40.8'W.) through Ambrose Nantucket Traffic Lane that expands from 1 mile to 5 miles wide. By entering the traffic lane 1 mile south of Lighted Whistle Buoy NC, a course of 100° follows the centerline of the outbound traffic lane to a point 4 miles abeam of Nantucket Traffic Lane Lighted Whistle Buoy NB (40°25.7'N., 73°11.5'W), thence a centerline course of 088½° to the end of the traffic lane. When seaward of Nantucket Shoals Lightship, steer usual courses to destination. Known, least depth in the traffic lane is 61 feet. Note: The Ambrose to Nantucket Traffic Lane passes 12.8 miles north of the departure point for passenger vessels and other vessels adhering to the North Atlantic Track Line Agreement; this lane is not intended to alter the practice of those vessels.

Separation Zone

The eastern separation zone between the inbound and outbound traffic lanes tapers from 3 miles to 1 mile wide centered on a line through Nantucket Shoals Lightship and three lighted whistle buoys 131, 170.5, and 193 miles, respectively, westward of the lightship.

Southeastern Directed Traffic Area

Hudson Canyon to Ambrose Traffic Lane, Inbound

The southeastward approach traffic lane to New York Harbor is entered near the 100-fathom curve at a point in about 39°24.8'N., 72°13.0'W., and tapers from 5 miles to 1 mile wide in its 91 mile length. A 312½° course from the entrance follows the centerline of the traffic lane to a point about 4 miles abeam of Hudson Canyon Traffic Lane Lighted Whistle Buoy HA (40°07.6'N., 73°21.4'W.), thence a centerline course of 305° to the junction with the precautionary area, and thence on a northwesterly course for about 8 miles to the pilot boat cruising area. Known, least depth in the traffic lane is 69 feet.

Ambrose to Hudson Canyon Traffic Lane, Outbound

The southeastward exit point for outbound vessels through the Ambrose-Hudson Canyon Traffic Lane, which expands from 1 mile to 5 miles wide, is about 7 miles 141° from Ambrose Light. A course of 140° follows the centerline of the traffic lane from the exit going to a point about 4 miles abeam of Hudson Canyon Traffic Lane Lighted Whistle Buoy HA (40°07.6'N., 73°21.4'W.), thence a centerline course of 132½° to the end of the traffic lane at the 100-fathom curve. The known least depth in the traffic lane is 77 feet.

Separation Zone

The southeastern separation zone between the inbound and outbound taffic lanes is centered on a line extending 132½° from Ambrose Light, and tapering from 3 miles wide at the 100-fathom curve to 1 mile wide at the junction with the precautionary area.

Southern Directed Traffic Area

Barnegat to Ambrose Traffic Lane, Inbound

The southern approach to New York Harbor is eastward of Barnegat Lighted Horn Buoy B (39°45.8'N., 73°46.0'W.) in Barnegat-Ambrose Traffic Lane that tapers from 5 miles to 1 mile wide in its 36 mile length. By entering the traffic lane 4 miles eastward of Barnegat Lighted Horn Buoy B, a course of 353° follows the centerline of the traffic lane to the junction with the precautionary area, and thence on a northwesterly course for about 8 miles to the pilot boat cruising area. The known least depth in the traffic lane is 72 feet.

Ambrose to Barnegat Traffic Lane, Outbound

The southern exit by outbound vessels is westward of Barnegat Traffic Lane Lighted Whistle Buoy BA (40°20.7'N., 73°47.7'W.) through the Ambrose-Barnegat Traffic Lane that expands from 1 mile to 5 miles wide. By entering the traffic lane 1 mile west of the Lighted Whistle Buoy BA, a course of 183° follows the centerline of the outbound traffic lane. When seaward of Barnegat Lighted Horn Buoy B steer usual courses to destination. The least reported depth in the traffic lane is 45 feet.

Separation Zone

The southern separation zone between the inbound and outbound traffic lanes tapers from 3 miles to 1 mile wide centered on a line through Barnegat Lighted Horn Buoy B and Barnegat Traffic Lane Lighted Whistle Buoy BA, 35 miles northward of Barnegat Lighted Horn Buoy B.

A Traffic Separation Scheme has been established off the entrance to Delaware Bay. The scheme is composed basically of directed traffic areas each with one way inbound and outbound traffic lanes separated by defined separation zones; a precautionary area; and a pilot boat crusing area. The scheme is recommended for use by vessels approaching or departing Delaware Bay, but is not necessarily intended for tugs, tows, or other small vessels which traditionally operate outside of the usual streamer lanes or close inshore. The Traffic Separation Scheme has been designed to aid in the prevention of collisions at the approaches to major harbors, but is not intended in any way to supersede or alter the applicable rules of the road. Separation zones are intended to separate inbound and outbound traffic lanes. They are to be free of ship traffic, and should not be used except for crossing purposes.

Mariners should use extreme caution when crossing traffic lanes and separation zones. The precautionary area for Delaware Bay entrance is inscribed by part of a circle with a radius of eight miles centered on Harbor of Refuse Light ($38^{o}48.9'$N., $75^{o}05.6'$W) and extending from off Cape May Point to the shore south of Cape Henlopen with the traffic lanes fanning out from the circumference of the circle. The outer part of the northeast quadrant of the area is full of shoals, and there are shoal spots covered from 28 to 33 feet in the western extension of the Five Fathom Bank-Cape Henlopen Traffic Lane, about 0.4 mile northward of Delaware Bay Approach Lighted Bell Buoy 2A. A charted wreck, about 1.2 miles north of Lighted Whistle Buoy FB, is just inside the precautionary area near the western extension of the Five Fathom Bank-Cape Henlopen Traffic Lane. In the southeast quadrant, the eastern limit of Hen and Chickens Shoal is marked by a red sector in Harbor of Refuge Light and Lighted Whistle Buoy 1 HC. The usable part of the precautionary area has depths of 33 to over 100 feet. Since the precautionary area is used by both incoming and outgoing vessels, making the transition between Delaware Bay and the traffic lanes, extreme care is advised in navigating within the area. The pilot boat cruising area is about a mile northeastward of Cape Henlopen.

Eastern Directed Traffic Area

Five Fathom Bank to Cape Henlopen Traffic Lane, Inbound

The eastward approach to Delaware Bay is north of Five Fathom Bank Lighted Horn Buoy F (38°47.3'N., 74°34.6W.) in Five Fathom Bank-Cape Henlopen Traffic Lane that tapers from 2 miles to 1 mile wide in its 16.4 mile length. By entering the traffic lane 1.5 miles north of Five Fathom Bank Lighted Horn Buoy F, a course of 268° follows the centerline of the traffic lane to the precautionary area, thence a course of 262° for about 3.5 miles passing southward of Delaware Bay Approach Lighted Bell Buoy 2A, thence a westerly course for about 2.5 miles to the pilot cruising area. Depths in the traffic lane vary from 37 feet or more in the eastern part to a reported 34 feet at the west end. Shoal spots covered 28 to 33 feet are in the western extension of the land inside the precautionary area, about 0.4 mile northward of Delaware Bay Approach Lighted Bell Buoy 2A. Avoid the charted wreck 2.9 miles west-northwestward of Five Fathom Bank Lighted Horn Buoy F, and the charted wreck, about 1.2 miles north of Lighted Whistle Buoy FB, just inside the precautionary area near the western extension of the lane.

Cape Henlopen to Five Fathom Bank Traffic Lane, Outbound

The eastward exit by outbound vessels is south of Five Fathom Bank Traffic Lane Lighted Whistle Buoy FB (38°47.3'N., 74°55.5'W.)

through Cape Henlopen-Five Fathom Bank Traffic Lane that expands from 1 mile to 2 miles wide. By entering the traffic lane 1 mile southward of Lighted Whistle Buoy FB, a course of 091½° follows the centerline of the outbound traffic lane. When seaward of Five Bank Lighted Horn Buoy F steer usual courses to destination. Depths in the traffic lane are 40 feet or more.

Separation Zone

The eastern separation zone between the inbound and outbound traffic lanes is 1 mile wide centered on a line through Five Fathom Bank Lighted Horn Buoy F, and two lighted whistle buoys 7.5 and 16.4 miles respectively, westward from the Five Fathom Bank Lighted Horn Buoy F.

Southeastern Directed Traffic Area

Delaware to Cape Henlopen Traffic Lane, Inbound

The southeastward approach to Delaware Bay is north of Delaware Lighted Horn Buoy D (38°27.3'N., 74°35.1'W.) in Delaware-Cape Henlopen Traffic Lane that tapers from 2 miles to 1 mile wide in its 24.2 mile length. By entering the traffic lane 1.5 miles northeastward of Delaware Lighted Horn Buoy D, a course of 312° follows the centerline of the traffic lane to the precautionary area, thence a continuation of the course for an additional 6.5 miles leads to the pilot cruising area. Depths in the traffic lane are 46 feet or more.

Cape Henlopen to Delaware Traffic Lane, Outbound

The southeastward exit by outbound vessels is southwestward of Delaware Traffic Lane Lighted Whistle Buoy DC (38°43.8'N., 74°57.6'W.) through Cape Henlopen - Delaware Traffic Lane that expands from 1 mile to 2 miles wide. By entering the traffic lane 1 mile southwestward of Lighted Whistle Buoy DC, a course of 134½° follows the centerline of the outbound traffic lane. When seaward of Delaware Lighted Horn Buoy D, steer usual courses to destination. Depths in the traffic lane are 46 feet or more.

Separation Zone

The southeastern separation zone between the inbound and outbound and outbound traffic lanes is 1 mile wide centered on a line through Delaware Lighted Horn Buoy D and three lighted whistle buoys 7.3, 14.7, and 24.2 miles, respectively, on a bearing of 313° from Delaware Lighted Horn Buoy D.

Chesapeake Bay

A Traffic Separation Scheme has been established for the control of maritime traffic at the entrance of Chesapeake Bay and off Smith Point Light (37°52.8'N., 76°11.0'W.) It has been designed to aid in the prevention of collisions, but is not intended in any way to supersede or alter the applicable Rules of the Road. The scheme provides for inbound-outbound traffic lanes marked by fairway buoys to enter or to depart Chesapeake Bay from the northeastward and from the southeastward. All traffic will leave these fairways buoys on their port hand entering or leaving Chesapeake Bay. The northeasterly inbound-outbound traffic lanes are separated by a line of five fairway buoys on bearing 250°-070°. The outermost buoy in the line is 6.4 miles 313° from Chesapeake Light and the innermost buoy is 2.5 miles 083° from Cape Henry Light. The southeasterly inbound-outbound traffic lanes are separated by a line of five fairway buoys on bearing 312°-132°. The outermost in the line is 7.1 miles 246° from Chesapeake Light and the innermost buoy is 2.5 miles 083° from Cape Henry Light.

APPENDIX 9

THE INFLUENCES OF PETROLEUM HYDROCARBONS AND HEAVY METALS ON MARINE FOOD WEBS

I. Biogenic and Petroleum Hydrocarbons

II. Uptake of Petroleum Hydrocarbons and Heavy Metals

III. Storage and Metabolism

IV. Discharge or Depuration

V. Food Web Magnification

VI. Microbial Decomposition

VII. Carcinogenicity

VIII. Heavy Metals

IX. Bibliography

I. Biogenic and Petroleum Hydrocarbons

Marine organisms contain and synthesize hydrocarbons under natural conditions. Some of the biogenic hydrocarbons which are important to the survival of the organism can be the same as or similar to the petroleum hydrocarbons (PHC) found in crude or refined oil. This fact has several implications. The detection of the origin of hydrocarbons can be difficult for the analytical chemist. Misidentification by consuming organisms or interference with chemical cues can have pronounced ecological effects. Because many petroleum hydrocarbons are natural components of the biosystem, they may be incorporated in the system without the interference or harm caused by others such as chlorinated hydrocarbons. Other petroleum hydrocarbons, however, may cause harm or interfere with certain biological processes.

Examination of crude oils and most refined products indicates that they are extremely complex mixtures of organic compounds of which hydrocarbons comprise the most numerous and abundant fractions.

In their extensive literature review, Anderson, Clark, and Stegeman (1974) indicated some basic differences between biogenic and petroleum hydrocarbons. Crude oil and oil products are varied mixtures that contain molecules of different size in fairly even distribution ratios. Conversely, organisms possess specific biosynthetic pathways which favor the production of hydrocarbons in preferred and consequently narrower size ranges. Petroleum hydrocarbons are rich in toxic aromatic hydrocarbons and cycloparaffins. They also contain isoprenoid hydrocarbons (alkanes with methyl branches) ranging from about C_{11} to C_{22} and beyond, while organisms are limited to isoprenoids in the range C_{19}-C_{20}. Crude oil is devoid of the olefins or alkenes which are abundant in most organisms.

Anderson et al. (1974) summarized the occurrence of the various classes of hydrocarbons from petroleum and biological origins.

Saturated Hydrocarbons (alkanes or paraffins)

Both short and long-chain alkanes occur naturally in marine organisms. They are not as toxic to organisms at low concentrations as the aromatics are, but they may cause anaesthesis and narcosis or interfere directly with reception of the chemical cues. They can interfere with feeding, nutrition and communication in aquatic organisms (Goldacre, 1968; Whittle and Blumer, 1970; Blumer et al., 1972). Branched alkanes including pristane, an isoprenoid, have been found in marine macroorganisms. In some plankton and fish, pristane is the most abundant alkane present. In organisms, the biogenic alkanes of C_{60} and smaller are predominantly odd-numbered chains, while in petroleum odd and even numbered chains occur in a 1:1 ratio.

Petroleum contains abundant amounts of saturated hydrocarbons. Crude oil and most refined oil contain a series of n-alkanes with chain lengths of C_1-C_{60}. Branched alkanes, including the isoprenoids pristane, farnesane and phytane, are also present. Long chain saturated hydrocarbons occur in petroleum and refined products except for lubricating oil.

Unsaturated Hydrocarbons (olefins or alkenes)

Alkenes often account for a major percentage of the hydrocarbons found in aquatic organisms, and include squalene in basking shark liver oil and cod liver oil, and the polyolefins, hexeicosahexaene and carotene, prevalent in algae. According to Blumer (1969) alkenes may serve in biochemical communications, but their exact biological roles are poorly understood.

Olefinic hydrocarbons are rarely present in crude oils, but are formed in some refining processes and are present in gasoline and cracked petroleum products.

Alicyclic Hydrocarbons

Hydrocarbons containing one to three non-aromatic rings are present in several herbs and other land plants. Most are classified as terpenes because of their biosythetic origin from isoprene.

Aromatic Hydrocarbons

Although Gerarde and Gerarde (1961) reported several instances of low-boiling aromatic hydrocarbons in land plants, the occurrence of aromatics in marine organisms is debatable. Blumer et al. (1969) did not isolate aromatic hydrocarbons from plankton, and DiSalvo et al. (1975) were unable to detect aromatics in mussels (*Mytilus californianus*) taken from unpolluted environments. As suggested by Borneff et al. (1968), higher boiling aromatics may be synthesized by marine organisms. Many species, including bacteria, metabolize polynuclear aromatics and excrete the oxidization products.

Aromatics, particularly naphthalenes, have repeatedly been reported as the most toxic of the hydrocarbons. Their interference with feeding activities and other biological processes is important and should be given prime consideration.

Aromatic hydrocarbons represent a large percentage of the components of crude oil and an even larger percentage of the components of a refined product.

Nonhydrocarbon Compounds in Petroleum

Although more than 75 percent of most petroleum is composed of hydrocarbons, many other compounds (some toxic) are present in varying concentrations. These include cresols, xylenols, naphthols, quinolines, pyridines, and hydroxybenzoquinolines which are of particular concern because of their great toxicity and solubility in water. Apparently, except for the UV-fluorescent examinations by Zitko and Carson (1970), no analyses of nonhydrocarbon components for use in estimating petroleum contamination of aquatic organisms have been reported. Unfortunately, no degradation studies using these compounds are in the commonly-accessible literature (Anderson et al, 1974).

II. Uptake of Petroleum Hydrocarbons

Hydrocarbons are available to marine organisms in several different physical and chemical forms and uptake is greatly influenced by these factors. Hydrocarbons are essentially hydrophobic compounds and consequently have very low solubilities in water, generally in the ppm to ppb range (National Academy of Sciences, 1975). Because of this hydrophobic characteristic, most of the oil in a slick will remain on the ocean surface or adsorb to particulate matter and become incorporated into the bottom sediments instead of dissolving in the water column. The relative percentages of hydrocarbons involved in each of these processes depend upon environmental variables such as temperature, wind speed, wave action, etc. Various types of hydrocarbons in the petroleum mixture, in other words, low molecular weight paraffins (alkanes) and aromatics, have relatively high solubilities in water, however, these compounds are relatively volatile and are for the most part, lost to the atmosphere by evaporation. Petroleum, therefore, is presented to pelagic organisms in dissolved, dispersed, or suspended (floating tar lumps) forms and to benthic organisms in dissolved, dispersed, suspended or sedimented forms.

Petroleum hydrocarbons (PHC) may enter the food web by several means. Petroleum adsorbed to living or dead particles may be ingested. Uptake of PHC by the ingestion of prey species which have accumulated PHC within body tissues can also occur. Another method is the uptake of dissolved or dispersed petroleum via the gills or body surface.

The importance of several of these uptake methods is still largely unknown, but will vary with the species involved, the method of feeding and respiration of the organisms involved, the habitat, the state of the sea, and the petroleum itself. Evidence indicates that the majority of hydrocarbons enter molluscs, crustaceans, and fish via gill membranes (Anderson, Clark, and Stegeman, 1974). It would seem logical then that this would also be an important method of uptake in other marine groups, although the relative importance of transport through the body surface of marine worms with exposed soft bodies is unknown. Although ingestion of contaminated food and sediment particles may be important in marine mammals and some fish, its relative relationship to the transport across body surface membranes is still unknown.

According to the National Academy of Sciences report (1975):

> Equilibration of hydrocarbons can occur between organisms and the seawater that passes over their gills or other membranes exposed to seawater. This may be the most important route for most aquatic animals since they process such large amounts of water during food collection and respiration. One can calculate from the hydrocarbons measured in coastal waters (Stegeman and Teal, 1973; Brown et al., 1973) of 10 μg/liter and a level in food of 10 mg/g that an animal would be exposed to more than an order of magnitude larger amount of hydrocarbons in the water processed to obtain oxygen for metabolism of the food than that amount present in the food itself. Stegeman and Teal believe that uptake from the water is the major route by which their oysters accumulated hydrocarbons from the water. In other situations, uptake from sediments could also be important.

Dissolved hydrocarbons were taken up by the gill tissue of the mussel Mytilus edulis, and then transferred to other tissues (Lee et al., 1972a). Electron microscopic studies on the uptake of iron suggest that the gill tissue of this mussel has a micellar layer on the surfaces of the gill that is responsible for the absorption of hydrophobic compounds (Pasteels, 1968). Work on the uptake of dissolved hydrocarbons by marine fish also demonstrated the entrance of hydrocarbon through the gills (Lee et al., 1972b).

Yevich and Barry (1970) reported on tissue damage brought about by exposure to crude oils and other pollutants; such damage includes sloughing of the epithelium and atypical basal cell hyperplasia of the ciliated inner gills of quahogs (Mercenaria mercenaria). The question also arises, then, as to the effect the loss of the protective membrane coatings of the gills has on the rate of absorption of hydrocarbons from water.

Invertebrates such as molluscs and barnacles, which have the ability to isolate themselves from the environment through shell closure may employ a behavior mechanism which protects them for limited amounts of time from excessive uptake of PHC. Stegeman and Teal (1973) exposed oysters, Crassostrea virginica, to varying concentrations of No. 2 fuel oil for two days. The data suggested that, for concentrations up to 450 ug/l (ppb), there was a direct relationship between the hydrocarbon concentration in the water and uptake rate, while at higher concentrations the rate of uptake fell (Figure 1). The reason for this was that the oysters remained tightly closed when exposed to concentrations of 900 mg/l. Even though oysters can tolerate many forms of environmental irritants so common in estuaries by shell closure and similar behavior mechanisms (Menzel, 1955), other marine molluscs may not exhibit the same degree of adaptability.

Even though PHC are taken into the gut through ingestion, they may not necessarily become incorporated into body tissues, but may instead be passed directly through the organism as feces. Following the Arrow incident in Chedabucto Bay, plankton were observed to ingest large quantities of Bunker C oil and eliminate them in the form of fecal matter (up to 7 percent Bunker C oil by weight) (Conover, 1971). The plankton always voided the small "oil" particles within 24 hours and showed no signs of stress when viewed under a dissecting microscope. No chemical analysis of the fecal matter or of the whole copepods was reported, however, which might have provided some indication of whether and what degree of degradation or partitioning of the oil took place.

Parker (1970) also demonstrated the presence of considerable quantities of oil in the guts and fecal pellets of copepods and barnacle larvae. The fact that the oil passes unchanged into the fecal material is of considerable interest since oil from a slick can be grazed by the plankton and the ingested oil concentrated in the feces. Parker (1971) calculated that copepods (Calanus finmarchicus) could encapsulate

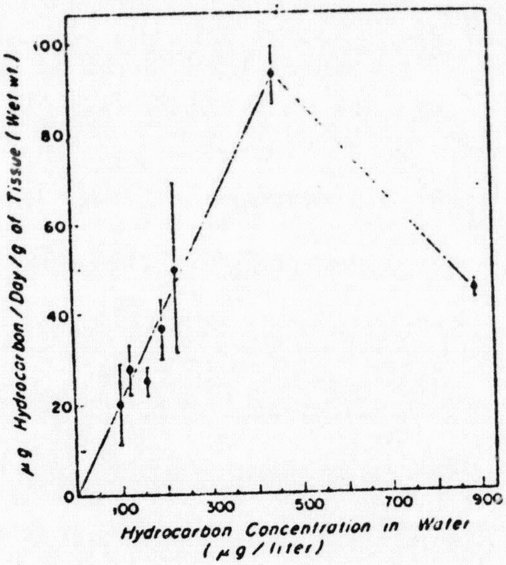


Fig.1. *Crassostrea virginica.* Initial rate of petroleum hydrocarbon uptake by oysters versus hydrocarbon concentration in the water. Oysters were assayed after 2 days exposure at indicated hydrocarbon concentration. Each point represents average of 2 determinations using high fat-content oysters

(From Stegeman and Teal, 1973)

up to 1.5 X 10^4 g of oil per day per individual. For example, a population of 2,000 individuals/m^3 covering an area of 1 km^2 to a depth of 10 m could remove as much as 3 tons of oil daily if the oil's concentration is 1.5 ppm or greater. Fecal pellets can then be eaten by other members in the food web.

Alyakrinskaya (1966) found that the mussel *Mytilus galloprovincialis* in the Black Sea could tolerate high concentrations of oil (up to 20 ml/liter of an undefined type of oil). During filtration of oil-polluted water, the molluscs formed pseudofeces from oil connected by mucous--to a degree comparable with transferring the oil to larger, denser particles as Conover and Parker have suggested for copepods.

According to Anderson et al. (1974), a significant amount of PHC is taken up and accumulated, at least temporarily, within the body tissues of most fishes and invertebrates during spills. Data shown in Table 1 (presumably contaminated tissues) and Table 2 (natural tissue hydrocarbon levels) should be treated with a certain amount of caution, however, because of the number of variables involved. The methods of analyses, UV absorption spectrophotometry, infrared spectrometry, mass spectrometry and the various chromatography procedures, measure hydrocarbons in a different manner and consequently produce slightly different results. The other significant variable is the composition of the oil itself.

TABLE 1 - Tissue Samples - Presumably Contaminated (from Anderson et al., 1974)

SPECIES	PROBABLE SOURCE	HC TYPE[1]	ANALYSIS	WET µg/g	REFERENCE
Macro algae					
Fucus sp.	Spill - Bunker C	n-paraffins	GC	5.8	Clark *et al.*, 1973
Snails					
Littorina littorea	Spill	Bunker C aromatics	Fluoro	27-600	Scarratt & Zitko, 1972
Thais lamellosa	Spill - #2 fuel oil	n-paraffins	GC	5.4	Clark, 1974
Clams					
Mercenaria mercenaria	Sewage effluent	C_{16-32}	GC	16	Farrington & Quinn, 1973
Mya arenaria	Spill	#2 fuel oil	GC/MS	26	Blumer *et al.*, 1970b
Oysters					
Crassostrea virginica	Chronic	paraffins, mono & di-aromatics	GC/MS TLC	236	Ehrhardt, 1972
	Harbor	C_{17-32}	GC	10	Stegeman, 1974
	Spill	#2 fuel oil	GC/MS	70	Blumer *et al.*, 1970a
	Chronic	Polynuclear aromatics	UV	1	Cahnmann & Kuratsane, 1957
	Chronic-harbor	Saturates	GC/MS	15	Meiggs, 1973 (Galveston)
	" "	"	GC	13-29	" " (San Francisco)
	" "	Total HC	GC	160	R.D. Anderson, 1973 (Galveston Red Bluff Reef)
	" "	Saturates, C_{12-24}	GC	11.2	R.D. Anderson, 1973 (Galveston Halfway Reef)
		Dimethylnaphthalenes	GC	0.6	"
		Trimethylnaphthalenes	GC	0.6	"
Mussels					
Modiolus modiolus	Spill	#2 fuel oil	GC	218	Burns & Teal, 1971
	Spill	Bunker C aromatics	Fluoro	21-372	Scarratt & Zitko, 1972
Mytilus edulis	Spill	"	"	77-103	Zitko, 1971
	Chronic - harbor	n-paraffins	GC	0.97	Clark & Finley, 1973b
	Spill - #2 fuel oil	"	GC	1.4	"
Mytilus californianus	Spill - Bunker C	"	GC	0.87	"

---

[1] Though only n-paraffins were indicated in some cases, the probable presence of other petroleum-type hydrocarbons, e.g. aromatics, is not to be excluded.

TABLE 1 (continued)

SPECIES	PROBABLE SOURCE	HC TYPE[1]	ANALYSIS	WET µg/g	REFERENCE
Scallops					
Acquipecten irradians muscle	Spill	#2 fuel oil	GC	7-14	Blumer *et al.*, 1970b
Barnacles					
Mitella polymerus	Spill - Bunker C	n-paraffins	GC	11.8	Clark *et al.*, 1973
Crabs					
Cancer irroratus	Spill	Bunker C aromatics	Fluoro	7-11	Scarratt & Zitko, 1972
Hemigrapsus nudus	Spill - Bunker	n-paraffins	GC	2.9	Clark *et al.*, 1973
Lobster					
Homarus americanus - gut	Spill	Bunker C aromatics	Fluoro	103-130	Scarratt & Zitko, 1972
stomach	"	"	"	15-230	"
claw muscle	"	"	"	2-3	"
Abdominal muscle	"	"	"	1-4	"
Urchins					
Stronglyocentrotus droebachiensis	Spill - Bunker C	Bunker C aromatics	Fluoro	17-94	Scarratt & Zitko, 1972
Mullet					
Mugil cephalus - flesh	Chronic - harbor	Kerosene taint	GC/MS	~860	Shipton *et al.*, 1970
Whitefish - flesh	Spill	Diesel oil	GC	29-88	Ackman & Noble, 1973
Flatfish	Chronic - coast	C_{14-20}	GC	4	Bowen, 1971

TABLE 2 - Natural Tissue Hydrocarbon Levels (from Anderson et al., 1974)

SPECIES	LOCALITY	HC TYPE	ANALYSIS	WET µg/g	REFERENCE
Macro Algae					
Nereocystus (kelp)	Puget Sound, Wash.	n-paraffins	GC	0.74	Clark, 1974
Ulva sp. (sea lettuce)	"	"	"	20.3-23.0	"
Fucus sp.	Puget Sound, Wash.	n-paraffins	GC	3.03-55.7	Clark, 1974
	Washington Coast	"	"	9.51-57.2	"
	New Hampshire	"	"	8.96	Clark & Blumer, 1967
	Woods Hole, Mass.	"	"	34.9	"
	Falmouth, Mass.	"	"	38.7	"
Snails					
Thais lamellosa	Puget Sound, Wash.	n-paraffins	GC	0.06-1.5	Clark, 1974
Littorina littorea	Eastern Canada	Aromatics	Fluoro	11	Zitko, 1971
Littorina sp.	Valdez, Alaska	n-paraffins	GC	16.1	Clark, 1974
Limpets					
Notoacmea scutum	Puget Sound, Wash.	n-paraffins	GC	2.5	Clark, 1974
Chiton					
Mopalia sp.	Puget Sound, Wash.	n-paraffins	GC	0.50	Clark, 1974
Clams					
Mercenaria mercenaria	Narrangansett Bay, R.I.	Total HC	GC	2.9	Farrington & Quinn, 1973
Mya arenaria	Eastern Canada	Aromatics	Fluoro	8	Zitko, 1971
Mya sp.	Valdez, Alaska	C_{16-28}	GC	1.1	Kinney, 1973
Rangia cuneata	Trinity Bay in Galveston, Texas	Naphthalene	UV Spec	0.16	Cox & Anderson, 1974
		Methylnaphthalene	"	0.11	"
		Dimethylnaphthalene	"	0.06	"

Table 2 (continued)

SPECIES	LOCALITY	HC TYPE	ANALYSIS	WET µg/g	REFERENCE
Oysters					
Crassostrea virginica	Redfish Reef in Galveston Bay	Saturated HC	GC/MS	1.5	Meiggs, 1973
	Aransas Bay, Texas	Saturated HC	GC/MS	1	Meiggs, 1973
	Quisset, Mass.	Total HC	GC	1-2	Stegeman & Teal, 1973
	Galveston Island East Lagoon	Total HC	GC	<2.0	R.D. Anderson, 1973
	Eight Mile Road Reef	"	"	<2.0	R.D. Anderson, 1973
	"	Saturated	"	<0.1	R.D. Anderson, 1973
		Aromatics	"	<0.1	R.D. Anderson, 1973
Ostrea edulis	Newport, Oregon	n-paraffins	GC	0.35	Clark *et al*., 1974
Mussels					
Mytilus edulis	Puget Sound, Wash.	n-paraffins	GC	0.37-21.6	Clark, 1974
	Valdez, Alaska	"	"	0.40-0.95	"
	Newport, Oregon	"	"	0.34	Clark *et al*., 1974
	Eastern Canada	Aromatics	Fluoro	3	Zitko, 1971
	Valdez, Alaska	C_{16-28}	GC	1.9	Kinney, 1973
Mytilus californianus	Washington Coast	n-paraffins	GC	0.45	Clark & Finley, 1973b
	Puget Sound, Wash.	"	"	0.088-0.58	Clark, 1974
Barnacles					
Mitella polymerus	Washington Coast	n-paraffins	GC	1.41	Clark *et al*., 1973
	Puget Sound, Wash.	"	"	1.22-4.54	Clark, 1974
Balanus cariosus	Washington Coast	n-paraffins	GC	0.66	Clark, 1974
Scallop					
Acquipecten irradians	Waquoit Bay, Mass.	Saturates	GC	2.3-55	Blumer *et al*., 1970a
Shrimp					
Pandalis borealis	North Atlantic	Saturates	GC	43.6	IDOE, 1972
Unidentified species	Arctic Ocean	n-paraffins	GC	0.37-21.6	Clark, 1974
Palaemonetes pugio	Galveston Island Marsh at Eight Mile Road	Saturated Total (C_{20-31})	GC	24.8	Tatem & Anderson, 1974
		(C_{22-26}, each)	"	3.1-3.9	"
		C_{23}	"	3.8	"

TABLE 2 (continued)

SPECIES	LOCALITY	HC TYPE	ANALYSIS	WET µg/g	REFERENCE
Palaemonetes pugio	Marsh at Eight Mile Road	Saturated Total (C_{21-26})	GC	10.9	Tatem & Anderson, 1974
		C_{23}	"	3.9	"
Penaeus setiferus (postlarvae)	Mariculture by Dow Chemical	Saturated Total	GC	15.0	Cox & Anderson, 1974
		Aromatics Total	"	8.0	"
Crabs					
Hemigrapsus nudus	Washington Coast	n-paraffins	GC	0.28	Clark *et al*., 1973
	Puget Sound, Wash.	"	"	0.082-3.65	Clark, 1974
Cancer irroratus	Eastern Canada	Aromatics	Fluoro	7	Zitko, 1971
Uca minax		Naphthalene	UV Spec	0.24	Cox & Anderson, 1974
		Methylnaphthalene	"	0.15	"
		Dimethylnaphthalene	"	0.09	"
Sesarma cinereum	Trinity Bay in Galveston Bay	Naphthalenes	UV Spec	0.22	Cox & Anderson, 1974
		Methylnaphthalenes	"	0.10	"
		Dimethylnaphthalenes	"	0.08	"
Lobster					
Homarus americanus					
stomach	Eastern Canada	Aromatics	Fluoro	19	Zitko, 1971
gut	"	"	"	57	"
claw muscle	"	"	"	4	"
abdominal muscle	"	"	"	5	"
Urchin					
Strongylocentrotus sp.	Eastern Canada	Aromatics	Fluoro	22	Zitko, 1971
S. purpuratus	Washington Coast	n-paraffins	GC	0.18	Clark, 1974
Flounder					
Syncium gunteri	Gulf of Mexico	n-paraffins	GC	8.7	IDOE, 1972
Unidentified species	Alaska	"	"	8.0	"

TABLE 2 (continued)

SPECIES	LOCALITY	HC TYPE	ANALYSIS	WET µg/g	REFERENCE
Flounder (cont.)					
Pseudopleuronectes americanus	Eastern Canada				
gut		Aromatics	Fluoro	21	Zitko, 1971
skin and flesh		"	"	0	"
Perch					
Sebastes marinus - livers	North Atlantic	Hydrocarbons	GC	110	IDOE, 1972
	George Bank	"	"	20.6	"
Haddock					
Gadus aeglefinus - livers	North Atlantic	Hydrocarbons	GC	210	IDOE, 1972
	George Bank	"	"	252	"
Pollock					
Pollachius verins - livers	Georges Banks	Hydrocarbons	GC	262	IDOE, 1972
Greenland habibut					
Reinhandtius hippolossoides - livers	North Atlantic	Hydrocarbons	GC	230	IDOE, 1972
	Gulf of Maine	"	"		
Whitefish - flesh	Alberta, Canada	Diesel oil-like	GC	4-14	Ackman & Noble, 1973
Yellow sole					
Lamanda	Valdez, Alaska	C_{16-28}	GC	0.51-0.97	Kinney, 1973
Herring eggs					
Clupea pallasil	Puget Sound, Wash.	n-paraffins	GC	3.1	Clark, 1974
Cod					
Gadus callarias - livers	North Atlantic	Saturates	GC	128-345	IDOE, 1972
Gadus morhua - livers	" "	"	"	332	"
Boreogadus esmarki	" "	"	"	117	"
	Arctic Ocean	n-paraffins	"	12.6	Clark, 1974

TABLE 2 (continued)

SPECIES	LOCALITY	HC TYPE	ANALYSIS	WET µg/g	REFERENCE
Mackeral *Scomberomorus cavalla*	Gulf of Mexico	n-paraffins	GC	11.3	IDOE, 1972
Barracuda *Sphyraena barracuda*	Texas	n-paraffins	GC	22.6	IDOE, 1972
Atlantic salmon *Salmo salar*	Eastern Canada	Aromatics	Fluoro	10	Zitko, 1971

According to Anderson et al. (1974)

> Levels of PHC contamination in a wide variety of edible marine organisms are listed in Table 1. The data shown in this table relate to organisms collected from localities presumed to be high in PHC contamination, and therefore the compounds detected are likely to be petroleum derived. These samples, presumed by the authors to be contaminated with petroleum, were in general judged so based on the types of hydrocarbons present, keeping in mind the differences between petroleum and biogenic mixtures. The hydrocarbon types are listed in Table 1 as indicated by the authors, and though only one class, or a range, of hydrocarbons is given for some samples, it does not exclude the presence of other types of compounds in the sample. Usually the samples analyzed by fluorescence yield low numbers and in most samples the concentration would be much higher if compounds other than polycyclic aromatic hydrocarbons were included. Those samples listing only "paraffins" should also be considered as reflecting a very small part of the total hydrocarbons. This is perhaps especially true for shellfish (Stegeman, 1974).

It is evident that high concentrations of PHC can be found in organisms from spill areas as well as areas of chronic contamination. In many cases, the hydrocarbon level of the waters from which organisms have been taken have not been reported. In other cases, under prolonged exposures, the concentrations could have fluctuated over such a wide range that such information would not realistically reflect the true exposure concentrations. The relative amount of accumulation varies greatly with the organism involved, concentration of hydrocarbon in the water, and composition of the petroleum, etc. On a dry weight basis, the actual amount accumulated can be quite substantial. Di Salvo et al. (1975) reported a preliminary determination of surface hydrocarbons showed the presence of 1.25 ppb while dry weight tissue from mussels, Mytilus edulus, exposed for 90 days was recorded as 300 ppm.

In contrast to the PHC concentrations in presumably contaminated organisms, concentrations of hydrocarbons in supposedly uncontaminated populations (Table 2) are consistently much lower. This is particularly true for the molluscs, where concentrations of 1 to 2 ppm or less are approximately 10 to 100 times lower than those of the contaminated organisms. "Natural" concentrations in some fish and crustaceans appear somewhat higher and in a few cases might be suspect, although these samples were all considered uncontaminated by the authors based on parameters other than the total hydrocarbon content (Anderson et al.,1974).

A striking feature of Table 2 is that these low levels occur in organisms from all coastal regions of the continent. The concentrations from 0.01 to 10 ppm are the lower limits of analysis based on current techniques and may in many cases represent mostly biogenic compounds. In such cases a few compounds can be expected to constitute the major portion of the hydrocarbon components.

There have to date been a number of studies describing the experimental accumulation of PHC by marine organisms. Table 3 summarizes results of most of these studies and indicates tissue levels of PHC which can be achieved under a variety of exposure conditions (Anderson et al., 1974). Most of the studies in Table 3 were performed under static conditions for relatively short periods, i.e. hours to days. The majority used very high exposure levels of emulsions, dispersions, water soluble fractions or slicks ranging from approximately 50 to 10,000 ppm.

Table 3. Tissue Hydrocarbon Levels Resulting from Laboratory Exposure.

SPECIES	EXPOSURE CONDITIONS	HC TYPE	ANALYSIS	WET µg/g	REFERENCE
Clams					
Rangia cuneata	1000 ppm #2 fuel oil, 48 hr	Total saturated	GC	26	Anderson, 1973
		Mono- & diarom.	"	481	"
		Poly aromatics	"	34	"
Mya arenaria	Bunker C	Aromatics	Fluoro	87	Zitko, 1971
Oysters					
Crassostrea virginica	1000 ppm #2 fuel oil, 48 hr	Total saturated	GC	4	Anderson, 1973
		Mono- & diarom.	"	121	"
		Poly aromatics	"	5	"
	1000 ppm #2 fuel oil, 96 hr	Total saturated	"	3.1	"
		Naphthalenes	"	84.1	
		Triaromatics	"	9.5	"
	106 ppb #2 fuel oil, 7 weeks	Saturates & arom.	"	335	Stegeman & Teal, 1973
	1000 ppm Kuwait crude, 96 hr	Total saturated	"	46.0	Anderson, 1973
		Naphthalenes	"	55.1	"
		Triaromatics	"	6.0	"
Crassostrea gigas	50 ppm #2 fuel oil, 11 days	Saturated	GC	1.3	Vaughan, 1973
Ostrea lurida	10% outboard motor effluent, 10 days	n-paraffins	GC	0.96	Clark et al., 1974
Mussels					
Mytilus edulis	0.1 ppm mono- & diaromatics 4-24 hrs	Same	Radio.	6	Lee et al., 1972a
	0.1 ppm poly aromatics	Same	"	0.6	"
	Slick, #2 fuel oil 48 hrs	n-paraffins	GC	7.9	Clark & Finley, 1974
	Slick, #5 fuel oil 32 hrs	"	"	7.4	"
	10% outboard motor effluent 1 day	"	"	1.10	Clark et al., 1974

(From Anderson et al., 1974).

Table 3. Continued.

SPECIES	EXPOSURE CONDITIONS	[illegible] TYPE	ANALYSIS	WET µg/g	REFERENCE
Shrimp					
Penaeus aztecus	20% WSF[1] #2 fuel oil, 24 hr	Sat. (individual peaks)	GC	0.1	Cox & Anderson, 1974
		Naphthalenes	"	0.1	"
		Methylnaphthalenes	"	1.4	"
		Dimethylnaphthalenes	"	0.3	"
		Trimethylnaphthalenes	"	0.6	"
Penaeus aztecus	Underslick of #2 fuel oil for 24 hr in a pond exposure	Saturated Total	GC		Cox & Anderson, 1974
		(C_{13-24})	"	6.2	"
		(C_4-Benzenes)	"	1.2	"
		Naphthalene	"	3.3	"
		1-Methylnaphthalenes	"	8.0	"
		2-Methylnaphthalenes	"	8.9	"
		Dimethylnaphthalenes	"	19.2	"
		Trimethylnaphthalenes	"	4.2	"
		Phenanthrenes	"	12.7	"
Palaemonetes pugio	0.9 ppm OWD[2] #2 fuel oil				
	for 2 hr	Naphthalenes	GC	3.1	Tatem & Anderson, 1974
	6 hr	Naphthalenes	GC	5.5	"
	10 hr	Naphthalenes	UV	4.0	"
Lobster					
Homarus americanus gut	10,000 ppm Bunker C, 6½ days	Aromatics	Fluoro	1,810	Scarrett & Zitko, 1972
stomach		"	"	2,840	"
abdominal muscle		"	"	137	"
claw muscle		"	"	33	"

---

[1] A water-soluble fraction (WSF) was prepared by mixing 1 part oil over 9 parts water for 20 hours, and the water phase was diluted to 20% of its original concentration of hydrocarbons (see Anderson et al., 1974)

[2] Oil was added to water such that 500 ml contained 0.9 ppm of oil. This mixture was shaken at 200 cycles/min. for 5 min. and after 60 min. the animals were placed in the mixture.

Table 3. Continued.

SPECIES	EXPOSURE CONDITIONS	HC TYPE	ANALYSIS	WET µg/g	REFERENCE
Perch					
Cymatogaster aggregata	50 ppm #2 fuel oil, 96 hr	Saturated	GC	2.3	Vaughan, 1973
		Diaromatics	"	19	"
Flounder					
Pseudopleuronectes	Bunker C				
americanus Gut		Aromatics	Fluoro	622	Zitko, 1971
skin		"	"	182	"
flesh		"	"	7	"

These could be taken as partially resembling the situation early in the history of an oil spill. Others were very brief status exposure to single compounds (Lee et al, 1972a), or long term exposure to low levels of whole fuel oil in a flow-through system (Stegeman and Teal, 1973). The last experiment could be considered to represent the conditions of an exposure to chronic sources of contamination in harbors, etc. In fact, the 335 ppm total hydrocarbon accumulated by oysters after seven weeks (Stegeman and Teal, 1973) was not very different from the 236 ppm total hydrocarbons in oysters from the Houston ship channel (Ehrhardt, 1972) shown in Table 1.

Based on dry tissue weight, Di Salvo et al., (1975) found hydrocarbon concentrations as high as 530 ppm in mussels exposed to low level chronic oil pollution in San Francisco Bay.

III. Storage and Metabolism

Although it has been demonstrated that hydrocarbons concentrate in certain organs, it is actually with the lipids that they become associated (Blumer, 1972). Stegeman and Teal (1973) found a direct relation between the lipid content of oysters and the amount of hydrocarbons accumulated. Shipton et al. (1970) reported the dark meat and the fatty layer adjacent to the skin were more severely tainted with a hydrocarbon similar to kerosene than the white meat, and that the tainted flesh had a higher fat content than the untainted flesh of fish caught at the same time. Vale et al. (1970) examined livers with optical and electron microscopes and found excessive amounts of free fat, typical of fatty infiltration, in tainted fish as compared with untainted mullet. Fatty liver in higher animals can be caused by petroleum distillates (Browning, 1953).

Roubal (1973), working with excised spinal cord tissues of coho salmon, indicated that hexane and similar hydrophobic compounds are directed away from nerve membrane surface to sites in the lipid bilayer of the membrane, while aromatic hydrocarbons and benzyl alcohol contribute to membrane surface changes. The complex lipoproteins of plasma membranes and organelle membranes of all tissues are possible storage sites (National Academy of Sciences, 1975).

According to a summary paper by Anderson et al. (1974), accumulated petroleum hydrocarbons are rapidly transferred to the gall bladder, brain and other neural tissues, and the liver of fish and to the digestive gland of shrimp. Damage to fish having concentrations of petroleum hydrocarbons in the nervous system can be seen as an increase in nonadaptive behavior responses.

Lee et al. (1972) and Anderson et al. (1974) found localization of hydrocarbons in the gall bladder, liver, and brain of marine fish. During depuration in clean water the hydrocarbons were apparently transported to the liver and gall bladder for detoxification and excretion. A signficant amount of contamination remained in the heart and brain until the point of final release. Since the compounds are transported by the blood, it is not surprising that the concentration in the heart is high, but an explanation for high levels in the brain requires further investigation.

Cox and Anderson (1974) reported that brown shrimp, Penaeus aztecus, accumulate the naphthalene fraction of hydrocarbons primarily in the digestive gland or hepatopancreas throughout the exposure period. The content of these compounds in the other organs and tissues decreases steadily, even during exposure. The gill tissue maintains a relatively consistent level of contamination (approximately 0.6 ppm) during the depuration until the point of final release by the digestive gland (about 250 hours). Since the gills are richly supplied with blood, the contamination level found may well represent contamination level in the blood of the shrimp.

Scarratt (1971) reported commercial species of scallops which had ingested Bunker C oil had a detectable amount of Bunker C hydrocarbons in the mantle, digestive gland, adductor mussel and gonad. Di Salvo et al. (1975) reported hydrocarbons in the gonads of mussels. Operation Oil (1970) reported that oil was present in the muscle tissue, digestive tract and other organs in scallops, periwinkles, sea urchins, and other intertidal benthos examined after Bunker C oil had been spilled in the Arrow accident. Blumer (1972) also reported hydrocarbons in adductor muscles of oysters after the West Falmouth spill.

The danger to the human consumer from PHC-contaminated sea food is lessened because hydrocarbons are primarily concentrated in certain organs such as the liver, gall bladder, and much of the nervous system which are discarded prior to consumption. The danger to humans who consume contaminated oysters, which are eaten in their entirety, would be significantly greater. Apparently some danger of oil contamination can occur from eating other molluscs which may have accumulated oil in muscle tissue.

Metabolism of hydrocarbons is discussed in the summary paper by the National Academy of Sciences (1975).

> The metabolic pathways involving oxidases and other enzymes, important in the degradation of aromatic and paraffinic hydrocarbons by mammalian systems, have been well studied. In the case of aromatic hydrocarbons, hydroxylation is followed by conjugation with sulfate or glucose and finally excretion of the water-soluble product. Straight chain hydrocarbons are hydroxylated at the terminal end and further oxidized to the fatty acid that can be broken down by β-oxidation. Highly branched chain hydrocarbons, such as pristane and phytane, are probably oxidized to an acid (e.g. phytanic acid), which can be further oxidized by a combination of α and β oxidation.

Metabolism of hydrocarbons in marine organisms is less well understood, but several studies have been conducted. Degradation of sizeable quantities (between 10 and 500 μg) of aromatic and paraffinic hydrocarbons did occur in marine fish and some marine invertebrates (Stegeman and Teal, 1973; Lee et al., 1972a,b). Other benthic marine invertebrates, phytoplankton, and some zooplankton, over a period of a month, were unable to oxidize either paraffinic or aromatic hydrocarbons. Several species of copepods were unable to metabolize hydrocarbons but could degrade paraffinic hydrocarbons (National Academy of Science, 1975). The liver or the liver-like organ in some invertebrates, the hepatopancreas, is assumed to be the site of hydrocarbon degradation Unaltered hydrocarbons are sent to these organs where hydroxylation and other detoxification reactions occur. In those invertebrates where degradation does not occur, some of the detoxifying microsomal oxidases in the hepatopancreas may be missing.

A somewhat less efficient and slower hydrocarbon metabolizing system has been reported in crustaceans (Anderson et al., 1974). Studies with molluscs have failed to demonstrate the presence of any hydroxylase activity (Carlson, 1972). Lee et al. (1972a) also failed to observe formation of metabolites of hydrocarbons by mussels.

According to Anderson et al. (1974)

> Though it is clear that levels accumulated vary with exposure conditions, some generalizations can be made: 1) In all types of exposures high levels of PHC can be found in the organisms. Here again the listing of only one type of hydrocarbon does not mean that other types of hydrocarbon were not present. In fact, the identification of only saturated compounds may yield numbers much lower than the total PHC present. 2) Monoaromatics and diaromatics appear to be more readily accumulated than either saturated compounds or PAH. In addition, long term exposure results indicate that changes in the composition of the retained hydrocarbons, especially a relative decrease in paraffins, occur throughout the exposure period. 3) It appears that the muscle tissue of fish and crustaceans accumulate relatively low levels of hydrocarbons. With the exception of molluscs which are entirely consumed by man, muscle is generally the edible portion of marine organisms.

IV. Discharge or Depuration of Hydrocarbons

Throughout the relatively short period since studies on oil accumulation in aquatic organisms began, evidence confirming and denying the ability to depurate accumulated hydrocarbons has been presented.

Blumer et al. (1970a) reported that when oysters *Crassostrea virginica* are exposed to water-oil mixtures, they nonselectively accumulate a wide variety of PHC in their tissues which are retained for several months or perhaps indefinitely.

Results from Blumer's (1972) study on highly aromatic No. 2 fuel oil suggest that oil becomes part of the organism's lipid (fatty) pool. Blumer noted that the oil in specimens observed from a Massachusetts oil spill remained relatively unchanged in composition or quantity. He reasoned that if the oil were localized within the digestive tract, a shellfish could eliminate it rapidly. But the persistence of the hydrocarbon over a time period of six months, its presence in adductor muscle tissue, and the lack of further degradation of these hydrocarbons indicated that it becomes part of the organism's lipid pool.

Lee et al. (1972) exposed the mussel *Mytilus edulis* to isotopically labeled petroleum-derived alkanes and aromatic hydrocarbons and showed that the molluscs released more than 90 percent of the accumulated hydrocarbons within two weeks of return to isotope free sea water.

Simulating the conditions of an oil spill, Anderson et al. (1974) have presented evidence that estuarine fish and macroinvertebrates completely depurate accumulated hydrocarbons after short term exposures of four days or less.

Anderson (1973) presented the detailed hydrocarbon composition of clam *Rangia cuneata* and oyster *Crassostrea virginica* tissue exposed to crude and refined oils for periods up to four days. The subsequent release of HC's accumulated from No. 2 fuel oil and South Louisiana crude oil by oysters was also reported. The levels of tissue contamination decreased to less than detectable concentrations (0.1 ppm) in from 24 to 52 days (Figure 2). The aromatic hydrocarbons were accumulated to the greatest extent and retained the longest in these studies.

Anderson and Neff (1974) have shown comparative data for the uptake and release of naphthalenes from No. 2 fuel oil by clams, fish, and shrimp. While approximately 0.8 ppm of total naphthalenes was still present in the clams *Rangia cuneata* at 360 hours, the fish *Fundulus* similis and shrimp *Penaeus aztecus* had released the hydrocarbons to background levels. It is interesting that even during the 24 hours of exposure the concentration in shrimp tissue dropped from about 70 ppm at 1 hour to approximately 3 ppm of total naphthalenes after 24 hours.

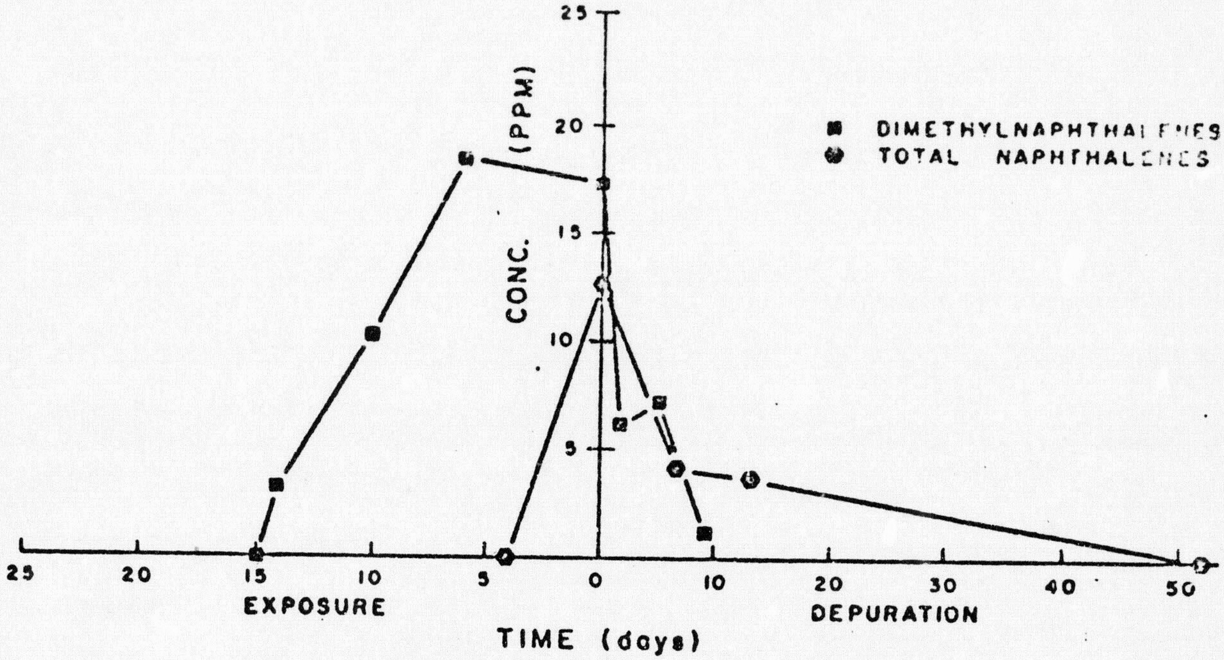


Figure 2. Levels of petroleum hydrocarbons in the tissues of marine organisms after various periods of exposure and depuration (in clean water). The levels of dimethylnaphthalenes in the tissues of Pacific oysters exposed to 50 ppm of South Louisiana crude oil (Vaughan, 1973); exposure of the American oyster, Crassostrea virginica, to an oil-water dispersion of #2 fuel oil total naphtalenes (Anderson, 1973). All data are expressed in µg/g fresh weight of organisms (ppm). (From Anderson et al., 1973).

Further evidence of the importance of naphthalenes in the contamination of the marine organisms is shown by the work of Vaughan (1973). During 15 days of exposure to oil, Pacific oysters were found to accumulate significant amounts of dimethylnaphthalenes. On removal from the contaminated water, the tissue content of dimethylnaphthalenes decreased to a level slightly above the background within nine days in clean flowing sea water (Figure 2).

It should not be assumed that only aromatic HC's are accumulated by marine animals, as Clark and Finley (1974) have demonstrated uptake of paraffins by mussels *Mytilus edulis* reaching a level of 112 ppm dry weight (7.9 mg/g wet weight) after 48 hours of exposure to No. 2 fuel oil. While the majority of these accumulated HC's were released during the first two weeks of maintenance in clean sea water, approximately 6 ppm (dry weight) was present at 14 and 35 days of depuration (Figure 3).

Mussels collected at Scripps showed a buildup of petroleum hydrocarbons for several days after a fuel oil spill. But three weeks later, none of the material could be found in the mussels (Lee and Benson, 1973). Fish from Alaskan waters were able to completely depurate accumulated hydrocarbons after short term exposures.[1] Several studies either designed to simulate chronic oil pollution

---

[1] Rice, personal communication, 1975.

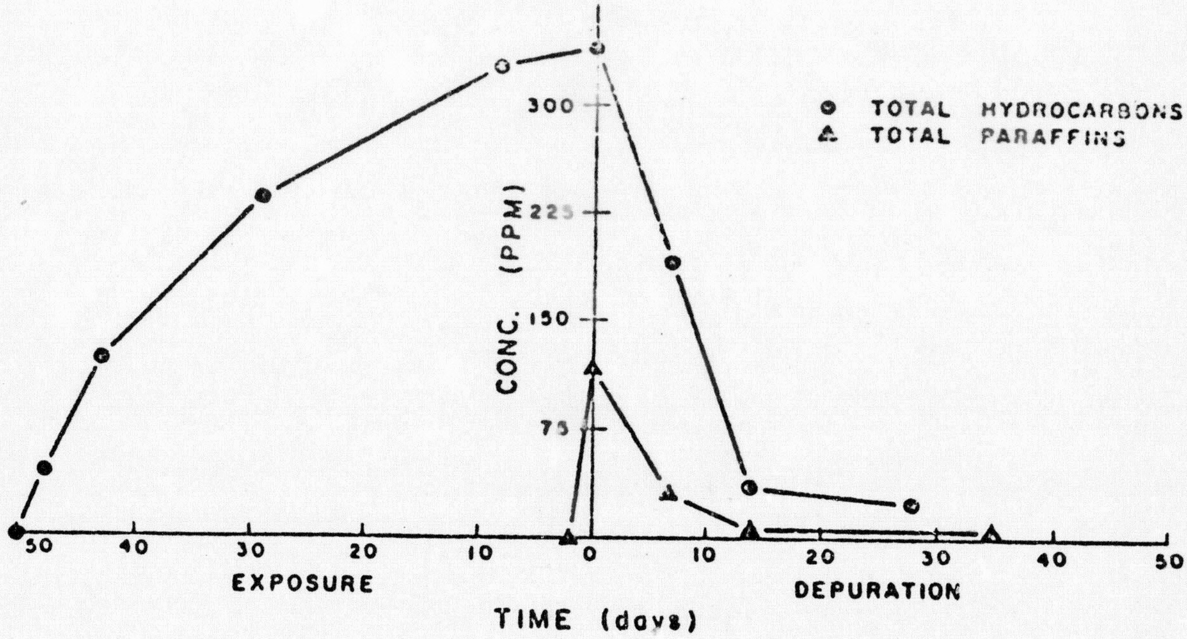
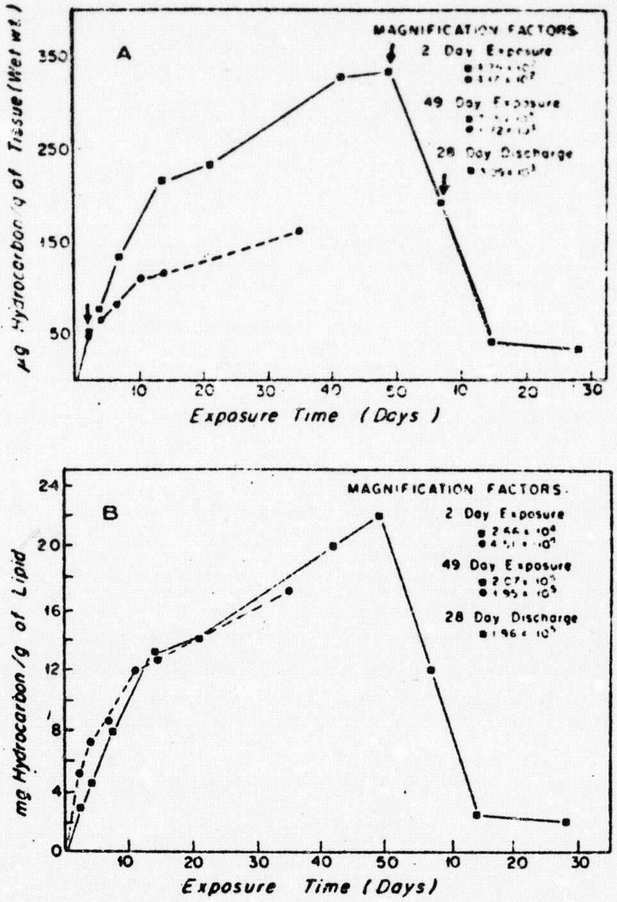


Figure 3. Levels of petroleum hydrocarbons in the tissues of marine organisms after various period of exposure and depuration (in clean water). Exposure of oysters to #2 fuel oil in a flowing system at a concentration of 106 ppb total hydrocarbons (Stegeman and Teal, 1973); the mussel, Mytilus edulis, exposed for 48 hours to surface oil slick total paraffins (Clark and Finley, 1974). With the exception of the data points for Mytilus which are expressed in µg/g dry weight of tissue, all additional data are expressed in terms of µg/g fresh weight of organism (ppm). (From Anderson et al., 1973).

or actually conducted in chronic field conditions, have indicated that, although over 90 percent efficient, molluscs do not completely depurate accumulated hydrocarbons.

Stegeman and Teal (1973) exposed oysters, Crassostrea virginica, to No. 2 fuel oil at a concentration of 106 ug/l (ppb) for 50 days In terms of total wet body weight, hydrocarbon accumulation increased rapidly for 13 days, then more slowly until equilibrium was reached in five to six weeks. In terms of lipid content, equilibrium was not reached during the 50 day exposure period. The amount of accumulation was dependent upon the fat content of the oysters, reaching 334 mg/g (ppm) in high fat oysters but only 161 mg/g (ppm) in low fat oysters. When placed in clean water having a background hydrocarbon level of 11 µg/l (ppb), oysters depurated 90 percent within the two week holding period, but retained a concentration of 34 mg/g (ppm), a concentration of over 30 times that before exposure (Figures 3 and 4). They concluded that at least some of the PHC had become a stable component having a slow turnover rate. There is a physiological advantage for marine organisms to avoid loss by equilibration of important biogenic hydrocarbons, and a certain amount of petroleum hydrocarbons were probably confused with biogenic hydrocarbons and retained this way.

Working with mussels, Mytilus edulis and M. californianus, in the natural environments of polluted (San Francisco Bay) and un-



Magnification Factors

2 Day Exposure
■ 4.25 x 10^2
● 4.17 x 10^2
49 Day Exposure
■ 3.15 x 10^3
● 1.72 x 10^3
28 Day Discharge
■ 3.09 x 10^3

2 Day Exposure
■ 2.66 x 10^4
● 4.51 x 10^4
49 Day Exposure
■ 2.07 x 10^5
● 1.95 x 10^5
28 Day Discharge
■ 1.96 x 10^5

Figure 4. Crassostrea virginica. Uptake and release of petroleum hydrocarbons by high fat-content (squares) and low fat-content (circles) oysters. Concentration of hydrocarbons expressed on (A) wet-weight basis, (B) lipid basis. The concentration of hydrocarbons in the water was 106 μg/l. At Day 50, high fat-content oysters were transferred to system with 11 μg hydrocarbon/l water. Each point represents determination of hydrocarbons in 3 oysters, with determinations in duplicate samples of three at Days 2 and 14. Magnification factors refer to concentration in the water. Concentration in low-fat oysters at Day 49 was determined by extrapolation.
(From Stegeman and Teal, 1973).

polluted (Northern California coast) areas, Di Salvo et al. (1975) reported incomplete depuration when mussels held in polluted areas for 90 days were transferred to nonpolluted areas and held for 10 weeks.

The evidence indicated there may be two forms of hydrocarbons accumulation in bivalve molluscs; (1) A short-term form where PHC are taken up rapidly and depurated completely or to background levels within several weeks to two months (Lee and Benson, 1973; Rice, and the work of Anderson et al. (1974). This reflects the response during an oil spill. (2) A long-term hydrocarbon burden accumulated in tissues that is not completely discharged (Blumer et al., 1970; Blumer, 1970; Stegeman and Teal, 1973; Di Salvo et. al., 1975). This reflects chronic oil pollution exposure when primarily aromatic hydrocarbons are accumulated in lipids. A similar residual hydrocarbon burden may be present in certain species of zooplankton, if it is possible to expose them to oil for a long enough period.

Because they apparently have the ability to metabolize hydrocarbons, shrimp, fish, and marine mammals would probably not retain the residual hydrocarbon concentration as do the molluscs.

The National Academy of Sciences (1975) reported on the avenues of depuration of accumulated hydrocarbons. In molluscs and certain zooplankton which cannot degrade hydrocarbons, bile salts or some other natural detergents are able to emulsify hydrocarbons and allow passage through the gut and into the feces or pseudofeces. Fish make water soluble products from the hydrocarbons, and the main avenue of discharge appears to be through the urine via the gall bladder and kidney. In mammals, aromatic hydrocarbons are also converted to water soluble products that go through the bile and into the feces and urine. The avenue for the discharge of hydrocarbons by the lobster and related invertebrates has not been determined.

Di Salvo et al. (1975) mention that another potential for the release of hydrocarbons may be in the eggs which, in mussels, were found to be enriched particularly with aromatic hydrocarbons compared to the total body concentration.

The present knowledge of depuration of petroleum hydrocarbons in marine animals is summarized by Anderson et al. (1974).

> It would seem that reduction of a body burden of hydrocarbons by metabolisms could have possible significance in fish, but probably not crustaceans or molluscs. As indicated above, however, all three groups are capable of disposing of accumulated PHC. The mechanisms responsible for disposal have yet to be clearly defined, particularly for crustaceans and molluscs, and for all three groups the real extent to which disposal occurs by release across gill membranes is still an unanswered question. With fish, where metabolism is a distinct possibility, there is information for only a few species and that very cursory. Rates of PHC metabolism in vivo under various environmental conditions are at this point impossible to guess. Furthermore, in terms of the consumer, we have no information regarding what percentage of PHC metabolites, some of which may be toxic (Daly et al., 1972), are retained or excreted by fish under varied conditions.

V. Food Web Magnification

There is increasing evidence that classical food web magnification (an increasing concentration of hydrocarbons per weight of tissue or lipid at successively higher trophic levels) of petroleum hydrocarbons does not occur. The principal evidence for this is: (1) Organisms so far tested have the ability to depurate at least the majority of accumulated hydrocarbons. Food chain magnification is dependent upon long term retention of the pollutant in tissues. (2) Much of the hydrocarbon ingested by zooplankton and other organisms passes through the gut without ever becoming accumulated into the body tissues. (3) The most important method of hydrocarbon accumulation is apparently transference across the gill surface. According to the National Academy of Sciences (1975) "Apparent food chain magnification may more likely be a function of the ability of different species to accumulate hydrocarbons from the water than a function of their position in the food web."

The possibility exists of some selective hydrocarbon buildup in the food chain in chronically polluted areas through molluscs which retain a portion of the toxic aromatic hydrocarbons. Although magnification would not occur, greater than normal levels of aromatic hydrocarbons could be passed on to the next trophic level. The resultant damage to the predator is not known, but would depend upon the concentration of aromatics in the prey, frequency of consumption, and toxicity or carcinogenicity of the particular aromatic hydrocarbons with the tissue of the prey organism.

The fact that the animals tested do accumulate hydrocarbons in rather large quantities in a relatively short time indicates that temporary food chain buildup can occur. The naphthalenes, which are among the most toxic petroleum fractions, remain within the prey species the longest (Anderson et al., 1974). The carcinogen benzo-a-pyrene acts similarly to naphthalenes in animal tissues. If the temporary accumulation of naphthalenes and/or benzo-a-pyrene reached high enough concentrations in predators, death or cancer could result. The impacts would be of far shorter duration and of less impact on the marine ecosystem than if the classical food chain buildup did occur.

There are other nonhydrocarbon components of oil (including but not limited to those discussed in Section I) which could be magnified through the food web. Very little information is available for many of these compounds and, although most occur in small concentrations, the long range effects are not completely understood.

Another possible implication of oil spills in the marine environment is a decrease in the available food supply due to the death of prey species which have succumbed to the toxic fractions of oil. A detailed discussion of this factor is beyond the scope of this paper.

VI. Microbial Decomposition

A necessary part of the food cycle in all systems is the decomposition of organic matter. Decomposition of petroleum hydrocarbons will be briefly discussed.

According to the report by the National Academy of Science (1975),

> It must be emphasized that with this multivariable system it is impossible to predict with either ease or accuracy the rate of microbial oil removal. Few reliable field measurements have been made in the marine environment (Blumer et al., 1973; Robertson et al., 1973); laboratory experiments, in which conditions, are optimal for oxidation can only give some indication of maximum rates. Even under laboratory conditions, the various fractions of oil or oil products will disappear at rates that can be measured on a time scale of weeks in some instances and that are immeasurable slow in others. Environmental stresses such as temperature and salinity changes, wave action, and sunlight not only directly affect the growth and metabolism of the microorganisms but also alter the physical state (for example, emulsification) and ultimately the chemical nature (for example, oxidation) of the hydrocarbons.

In sediments, chemical degradation of oil can occur but is restricted to the layer of the bottom penetrated by ultraviolet light. Ahearn (1973) stated that research on microbial utilization of hydrocarbons for treatment of oily pollutants in the environment, though more intensive in recent times, is still in an early stage of development. It is known that microorganisms can degrade much of a crude oil, particularly the less toxic paraffinic compounds. No single species can degrade all the compounds, but many different species together can metabolize a large number of the compounds.

Microbial degradation is principally aerobic and large quantities of oxygen are needed. It has been estimated, for instance, that complete oxidation of 1 gallon of crude oil would require all of the dissolved oxygen in 320,000 gallons of water. It is reasonable to assume, however, that an oxygen deficient environment could occur under some oil slicks and in oil contaminated sediments. Much of the oil from the Santa Barbara blowout, for example, is believed to have settled in the Santa Barbara Channel (Battelle Northwest, 1970) where oxygen is already deficient and is probably insufficient for further decomposition.

Blumer and Sass (1972) noted that "The preservation of hydrocarbons in marine sediments for geoligically long time spans is one of the accepted key facts in current thought on petroleum formation." However, in spite of the stability of hydrocarbons in marine sediments, there are characteristic differences between hydrocarbons found in polluted and unpolluted areas. Tissier and Oudin (1973) found that hydrocarbons in polluted sediments differed from those of unpolluted sediments by having lower percentages of heavy components . having an odd carbon dominance in the n-alkanes, and having polycyclic aromatic hydrocarbons with alkyl sidechains.

Numerous intermediates and end products have been identified in laboratory experiments (Friede et al., 1972; Klug and Markovetz, 1971), some of which may be disruptive to chemotaxic mechanisms of marine forms (Mitchell et al., 1972; Zafiriou, 1972). The microorganisms that digest oil may be pathogenic or produce toxins (Traxler, 1973).

The influences of environmental factors on decomposition rates has been summarized by the National Academy of Science (1975) report.

> Temperature increases may accelerate growth rates, thereby increasing biodegradation (Friede et al., 1972; ZoBell, 1973). A rise in temperature also increases the rate of evaporation of more volatile components, some of which are degradable and some of which are toxic (Atlas and Bartha, 1972b; see also previous section). Viscosity is lower at higher temperatures, thereby increasing the chance of emulsification and increasing the surface area available for microbial activity and solubility (ZoBell, 1973). Temperature decreases may not necessarily reduce the overall rate of microbial biodegradation significantly if special psychrophilic cultures develop (Robertson et al., 1973; Traxler, 1973).
>
> Oxygen content is probably always sufficient for degradation of oil at the surface layer and in the upper water column in the open ocean (Friede et al., 1972). The degree of turbulence directly affects the availability of oxygen, as well as the physical dispersion and emulsification of the oil. If the water or sediments become anoxic, then rates of biodegradation will be markedly reduced (Davis, 1967).
>
> Nitrogen and phosphorus concentrations strongly influence the rate of oxidation in laboratory experiments (Gunkel, 1967, 1968; Atlas and Bartha, 1972a). These nutrients may more commonly be limiting in the open oceans than in inshore regions.

Numerous other factors influence biodegradation, for example, presence of sufficient hydrocarbon substrate to develop a viable culture, presence of alternative carbon sources and microbial predators (Gunkel, 1968; Friede et al., 1972), but data are generally insufficient to precisely determine in situ effects on microbial oil utilization.

VII. Carcinogenicity

As far as man is concerned, some doubt remains as to the direct carcinogenicity of crude oil and crude oil residues in marine organisms.

A literature search and evaluation conducted for the U.S. Coast Guard by Batelle Memorial Institute (1967) noted that shellfish, although alive, may have been unfit for consumption because of the carcinogenic hydrocarbon 3, 4-benzopyrene in their bodies. Oysters that were heavily polluted and contaminated with ship fuel oil were reported to contain 3, 4-benzopyrene. The Batelle review also reported that barnacles attached to creosoted poles contained the same carcinogenic hydrocarbon. Sarcomas were developed when extracts from the barnacles were injected into mice.

The carcinogenic benzo-a-pyrene behaves similarly to naphthalenes in pattern of uptake, retention, and release in clams (Anderson and Neff, 1974). As indicated earlier, they reported that organisms accumulated naphthalenes in tissues in greater amounts than the other hydrocarbons and released them more slowly.

Hyperplasia (increase in the rate of cell division) in reproductive cells of bryozoan in response to the addition of coal tar derivatives was reported by Powell, Sayce, and Tufs (1970).

They noted that similar abnormalities may have occurred in coastal fauna exposed to spills such as the Torrey Canyon and the Santa Barbara blowout. However, most observations of these spills were concerned with mortality and may not have detected the sublethal effects. Straughan and Lawrence (1975) investigated the response of a number of bryzoan species to exposure to natural oil seepage, but found normal cell formation.

ZoBell (1971) reported the natural synthesis and metabolism of carcinogenic hydrocarbons by several marine organisms. Thus, oil pollution is certainly not the only source for carcinogenic hydrocarbon introduction into marine food webs. Suess (1972) recognized that carcinogens were in seafoods but concluded that they would probably not be dangerous unless the foods contained an excess amount of polynuclear aromatic hydrocarbon carcinogens. Carcinogenesis from oil contaminated marine organisms has not been proven, but Ehrhardt (1972) expressed a need for carcinogenic testing of hydrocarbon fractions extracted from marine organisms contaminated by exposure to oil.

According to the National Academy of Sciences (1975) workshop on petroleum in the marine environment:

> Although our information is limited, the effect of oil contamination on human health appears not to be cause for alarm. From our calculation, we estimate that the carcinogen benzo-a-pyrene concentration on a dry weight basis arising from a high level of contamination by petroleum is comparable with that of common terrestrial foods. We, of course, do not recommend eating contaminated

> seafood, but in most cases, because of the taste factor, not many will be tempted to do so. It is clear that this is an area in which our knowledge is grossly inadequate and that the contamination of seafood by oil is clearly undesirable.

Recent work by Yevich, of the National Marine Water Quality Laboratory in Naragansett, Rhode Island, has further implicated petroleum as a carcinogen. During two oil spills involving No. 2 fuel oil and a No. 5 diesel oil, he found two types of cancer in soft shell clams. One type forms in gonadal tissue and quickly spreads to other organs, while the other is a blood cell form similar to leukemia (Yevich, in press).

If Yevich's results prove to be valid, there should be greater cause for alarm than indicated by the National Academy of Science report.

VIII. Heavy Metals

Natural Occurrence and Sources from Offshore Petroleum Operations

Heavy metals occur naturally in sea water in relatively low concentrations. Table 4 lists average background concentrations in the open ocean for several heavy metals that have been associated with offshore petroleum operations. The residence time of the metal ions and their complexes is an estimate of turnover time in the marine environment. It must be emphasized that there are many dynamic physical and biological processes in the ocean that continually affect these "average" concentrations. Generally the concentrations in Table 4 would be applicable to the open ocean area away from the direct influence of the coastal zone. In the coastal zone, especially in estuaries, near river mouths and in areas of high levels of industrial or municipal discharges, the concentrations can be several times higher.

Natural sources of heavy metals to the ocean are river water, wind blown material from land following the weathering of rocks and tectonically active ridges where heavy metals are emitted in heavy brines. In coastal regions, additional major sources of heavy metals include sewage discharges, industrial effluents and atmospheric pollution. As an example of the atmospheric source, Patterson and Settle (1974, as cited by NSF/IDOE, 1974) found that atmospheric particle input is a major source of industrial lead in the Southern California Bight, comparable to the input of lead from storm runoff, rain and sewage. The atmospheric lead originates from cars burning leaded gasoline.

Many heavy metals in trace amounts are essential for animal and plant life. At present fourteen trace elements are known to be essential

Table 4 Background Concentrations of Most Heavy Metals in the Ocean

Element	Seawater conc. µg/l (ppb)	Principal Dissolved Species	Residence Time in Ocean (years)
- V	2	$VO_2\ (OH)^{-2}$	8.0×10^4
- Cr	0.5	CrO_4^{-2}, Cr^{+3}	2.0×10^4
- Mn	2	Mn^{+2}	1.0×10^4
- Fe	3	-	2.0×10^2
- Co	0.4	Co^{+2}	1.6×10^5
- Ni	7	Ni^{+2}	9.0×10^4
- Cu	3	Cu^{+2}	2×10^4
- Zn	10	Zn^{+2}	2×10^4
- As	2.6	$HAs\ O_4^{-2}$ $H_2As\ O_4^{-1}$	5×10^4
- Cd	0.1	Cd^{+2}	-
- Ba	20	Ba^{+2}	4×10^4
- Hg	0.2	$Hg\ Cl_4^{-2}$, $Hg\ Cl^o{}_2$	8×10^4
- Pb	0.03	Pb^{+2}	2.0×10^3
- Ag	0.04	Ag^{+1}	2.1×10^6

Modified from: Goldberg et al. (1971).

for animal life: iron, zinc, copper, manganese, cobalt, iodine, molybdenum, selenium, chromium, tin, nickel, fluorine, silicon and vanadium. These elements serve as components of enzymes or enzyme systems, enzyme activators, and components of vitamins, hormones and respiratory pigments. A few heavy metals such as arsenic, lead, cadmium and mercury are often referred to as toxic elements since they are toxic to marine organisms at relatively low concentrations and have no other known biological significance (Underwood, 1974). However, any of the heavy metals normally accumulated by marine organisms can be toxic if they are ingested or taken up at sufficiently high levels for long enough periods. Heavy metals and other trace metals in marine organisms are held by strong chemical bonds and are not readily released into the marine environment (Goldberg, 1965).

Offshore petroleum operations are potential sources of heavy metals to the coastal waters. Heavy metals are present in petroleum, formation waters (oil field brines) and drilling fluids. Crude oils vary greatly in trace element composition, and variations in trace element groups can occur from well to well in a particular geological formation (Filby and Shah, 1971). Concentrations of heavy metals and other trace elements in several crude oils are presented in Table 5. Nickel (Ni) and vanadium (V) are generally the most abundant metallic elements in crude, but as shown in Table 5, cobalt (Co), mercury (Hg), iron (Fe) and zinc (Zn) can be abundant in some crudes, in this case California crude. According to Filby and Shah (1971), very little is known fo the forms of occurrence of trace elements other than Ni and V in crude oil. Ni and V occur partly as porphyrin complexes and partly in non-porphyrin type compounds associated with the high-molecular-weight material of the oil. The resins

Table 5

Trace Element Contents of 6 Crude Oils[a]

Elemental Conc(µg/g)[b]	Oil Number					
	RF-1	RF-2	RF-3	RF-4	RF-5	RF-6
Ni	93.5	113.0	78.6	116.8	1.28	20.5
V	7.5	6.0	4.9	112.0	26.0	8.2
Co	12.7	13.9	14.5	0.198	0.001	0.0354
Hg	21.2	1.49	1.46	0.139	0.0143	0.0898
Fe	73.1	77.2	89.5	36.9	<5.0	4.94
Zn	9.32	19.50	19.60	2.619	<0.0907	9.08
Cr	0.634	0.685	0.729	0.380	<0.1	0.081
Mn	2.54	3.10	2.96	0.21	<1.50	0.79
As	0.656	1.63	0.67	1.20	<0.2	0.0773
Au	2.8×10^{-6}	....	....	3.0×10^{-6}	$<10^{-7}$	6.4×10^{-5}
Sb	0.0517	0.061	0.11	0.273	$<10^{-3}$	0.055
Se	0.364	0.484	0.333	0.369	0.009	0.128
Sc	8.8×10^{-3}	9.0×10^{-3}	4.6×10^{-3}	4.4×10^{-3}	9.5×10^{-5}	$<10^{-5}$
Cu	0.93	1.25	1.13	0.21	<0.2	0.19
Na	11.1	65.2	15.5	25.0	<1.0	13.0
Ca	192.0	75.1	103.0	150.0	<20.0	<20.0

[a] Oils RF-1, 2, 3 from California; RF-4, Venezuela; RF-5, Louisiana and RF-6, Libya

[b] Conc = concentrations in ppm

From Filby and Shah (1971)

and aspahltenes contain most of the trace elements. These groups are not definite classes of compounds but are colloidal materials covering broad molecular-weight and polarity ranges (Filby and Shah, 1971).

Formation waters contain heavy metals in various concentration ranges. Formation waters are either discharged into the ocean after separation of oil fractions or reinjected into formation reservoirs. Median concentrations of various trace metals in formation waters are given in Table 6.

Drilling muds used during drilling operations may be discharged periodically or accidentally into the ocean. Because of this, concern has been expressed over the introduction into the marine environment of toxic substances since the two major components of drilling mud are barite (barium sulfate) and ferrochrome lignosulfonate which contain the elements barium and chromium, known to be toxic in certain of their elemental states. A recent conference on the environmental aspects of chemical use in well-drilling operations in May, 1975 in Houston, Texas addressed these and other problems. The following information can be found in the report of the conference.

Barium sulfate, used as a weighting agent during drilling, is also used as a contrast medium for roentgenographic purposes and as an antidiarrheal and demulcent powder. Toxicity studies using Mollienisias latipinna (mollies) show that heavy concentrations of barium sulfate (up to 100,000 ppm for 96 hrs) exhibit no toxicity to fish (Grantham and Sloan, 1975).

Table 6

MEDIAN CONCENTRATIONS OF TRACE METALS IN PRODUCED WATERS a)

Median concentration (equaled or exceeded by 50% of the samples) in each area[1]

	Number of samples	Total solids (median) (g/l)	Co	Cr	Cu	K	Li	Mg
Illinois Basin	22	98	ND	2p	10p?	300	15	6,000
Louisiana and Texas Gulf Coast	79	69	ND	<1p	<25p	300	ND	250
East Texas	88	66	ND[2]	ND	< 1.	<50	ND	250
North Texas	24	222	ND	<1p	150p	300	ND	5,000
West Texas and New Mexico	148	111	ND	2p	1p	350	15.	1,000
Permian only	74	163	ND	2p	2p	400	10	1,000
Pennsylvanian only	34	115	ND	3p	< 1p	300	10	1,000
Silurian-Devonian only	15	55	ND	2p	4p	300	10	400
Ordovician-Cambrian only	21	67	ND	<2p	4p	400	15	800
Anadarko Basin[3]	118	137	ND	10p	10p	250	10	1,550
Williston Basin, post-Paleozoic	25	59	<5p	<2p	<25p	300	ND	250
Williston Basin, Paleozoic	55	173	ND	3p	3p?	800	35	600
Powder River Basin	22	5	<5p	<2p	<25p	300	ND	40
Other Wyoming	28	5	ND	ND	ND	300	ND	100
Colorado	18	5	<5p	ND	<25p	300	ND	30
California	116	18	ND	5p	5p	45	ND	90
Seawater	-	35	0.27p	0.04p-0.07p	1p-15p	380	0.1	1,272
Estimated Detection Limit	-	-	1p	1p	1p	50	2	10

	Mn	Ni	Sn	Sr	Ti	V	Zr
Illinois Basin	175p	ND	< 1p	300	<10p	ND	<10p
Louisiana and Texas Gulf Coast	3.5	<1p	< 1p	85	<10p	ND	<10p
East Texas	3.3	<1p	3p	350	ND[2]	ND[2]	ND
North Texas	45	15p	12p	450	7p?	ND	<10p
West Texas and New Mexico	1.8	<1p	< 1p	200	<10p	ND	ND
Permian only	1.7	<1p	< 1p	90	<10p	<1p	ND
Pennsylvanian only	2.8	<1p	< 1p	300	<10p	<1p	ND
Silurian-Devonian only	300p	<1p	1p	90	<10p	ND	ND
Ordovician-Cambrian only	400p	<1p	1p	250	<10p	ND	ND
Anadarko Basin[3]	5.6	6p	2p	300	<10p	<1p	<10p
Williston Basin, post-Paleozoic	300p	<3p	< 1p	100	ND	<1p	ND
Williston Basin, Paleozoic	660p	ND	< 1p	95	<10p	<1p	ND
Powder River Basin	450p	<3p	< 1p	25	<10p	<1p	<10p
Other Wyoming	300p	ND	< 1p	20	<10p	<1p	ND
Colorado	300p	<3p	<10p	20	<10p	<1p	<10p
California	950p	10p	2.5p	10	<10p	<1p	ND
Seawater	1p-10p	5.4p	3p	13	Present	0.3p	ND
Estimated Detection Limit	1p	1p	1p	16	10p	1p	10p

a) Taken from Rittenhouse, Fulton, Grabowski, and Bernard

[1] ND = below detection limits; p = concentration in parts per billion, otherwise parts per million.

[2] No data; less sensitive methods of analysis used.

[3] Includes Oklahoma Platform and Ardmore Basin.

Another report shows low toxicity but some physical problem with Salmo salar, Atlantic salmon because of suspended solids (Zitko, 1975) Conentrations of these magnitudes would exist only at the point of discharge.

Ferrochrome lignosulfonate is used as a deflocculant or thinning agent in drilling muds. Whereas chromium itself is highly toxic to certain species, when bound it is less toxic (Zitko, 1975) and it has been shown that in ferrochrome lignosulfonate the chromium is firmly chelated and may not be removed from the lignosulfonate complex even by strong ion-exchange resins and that the chromium is in the trivalent oxidation state (McAtee and Smith, 1969). Toxicity studies using Mollienisias latipinna (mollies) have indicated that the compound itself is of low toxicity (killed some test animals at 70 to 450 ppm concentrations). These concentrations could be found near discharge points (Hollingsworth and Lockhart, 1975).

Heavy metals can also be introduced into sea water by the dissolution of drilling platform legs and pipelines. The metals released would be iron with lesser amounts of nickel and molybdenum. The time required for metal decomposition through chemical and microbial erosion is not presently known, but with present safeguards, may be around ten years. Dissolution would occur at a very slow rate and should not appreciably add to the concentration of heavy metals around platforms and pipelines in the water column or in sessile marine organisms, although this has yet to be demonstrated.

Concerning the levels of concentration of heavy metals in the marine environment, IDOE (1972) concluded that with the possible exception of lead, the current levels of heavy metals in marine ecosystems are derived primarily from natural rather than technological sources. However, local inputs in the estuarine and coastal environments can increase the levels in the water column, sediments and marine organisms. In a study of the effects of offshore petroleum operations on the environment, in the Gulf of Mexico, the Gulf Universities Research Consortium (GURC) concluded that all the heavy metals observed in the water column were in the ranges reported for oceanic waters except for barium for which the results were inconclusive. A zinc concentration gradient was found that decreased with distance from the oil platforms (GURC, 1974). However, the investigation did not analyze distribution of heavy metals in the marine organisms or in the sediments.

Uptake

Marine organisms can accumulate heavy metals by absorption across body surfaces and gills from the water or by ingestion of food containing heavy metals. Food sources can include heavy metals adsorbed onto suspended particles or plankton, heavy metal compounds that have precipitated into the sediments and been ingested by deposit feeders, and heavy metals concentrated by organisms and preyed upon by other organisms in higher levels of the food web.

Once heavy metals are introduced into the ocean, concentrations are lowered by dilution and removed from sea water by precipitation, adsorption, and absorption by marine organisms. The amount of dilution depends on the currents, mixing and circulation patterns in the area of discharges as well as the medium in which the metals are discharged. For example, heavy metals introduced in crude oil or formation water of greater density than the surrounding water would probably tend to mix less with the ambient water mass and retain their higher concentrations for a longer period of time. The use of diffuser technology in many sewage outfalls helps to dilute the effluents faster and prevents a large dose of highly concentrated effluent impacting one area at one time.

Precipitation of a metal to the sediments occurs if the concentration of the metal is higher than the solubility of the least soluble compound that can be formed between the metal and anions in the water such as carbonate, hydroxyl or chloride. The concentrations of heavy metals which can remain in solution are orders of magnitude higher than those usually found in the sea and normally the sea is considerably undersaturated with heavy metals (Bryan, 1971).

Adsorption of metals can occur on the surfaces of suspended and deposited particulate matter such as clays, phytoplankton, hydrated ferric oxide and hydrated manganese dioxide. However, all heavy metals are not equally readily adsorbed. Zinc, copper and lead are probably readily adsorbed by both hydrated ferric oxide and hydrated manganese dioxide, but cobalt and nickel prefer hydrated manganese dioxide while silver is not readily adsorbed by either (Bryan, 1971). According to Lowman et al. (1971), surface adsorption, including ion exchange, is probably an important uptake path for phytoplankton. Glooschenko (1969) found that the greatest uptake of mercury-203 (^{203}Hg) per cell in a population of coastal marine diatoms (*Chaetoceros costatum*) was by adsorption onto a population killed with formalin rather than uptake by absorption of living cells. This passive uptake for the dead cells could also be due to increased membrane permeability to the mercury. In either case, the uptake by adsorption was greater than the active absorption process of live cells.

It has been found that heavy metals in natural waters are predominantly associated with particles suspended in water. Whenever attempts have been made in the natural environment to detect the amounts of heavy metals in solution versus the amount adsorbed onto or part of particles, investigators have discovered that only a small percentage of the heavy metals are in solution. It is not known if the particles that have adsorbed the heavy metals can be absorbed. It is generally thought that the particles must be ingested or taken into cells by phagocytosis and that the metal must be solubilized to be absorbed in solution (Hartung, 1972).

Uptake by absorption from sea water through the gills, body surface or gut wall is an important pathway for heavy metals to enter marine organisms. As noted by Anderson et al. (1974), the accumulation of heavy metals by marine organisms from dilute sea water solutions has been well demonstrated. The amount of heavy metal absorbed depends on many physical and chemical factors such as the concentration of the heavy metal in solution, the chemical form of the complex, the ligands available for complexing the metals, particle size, the nature of the particles available for adsorption in the water, pH and alkalinity. Biological characteristics of the organism also affect the absorption rate and amount: the species of the organism, age, metabolic rate, and previous health (Hartung, 1972). A further complicating factor is that an equilibrium may be established between the organism, its food and the concentration of the heavy metal in the water (Lowman et al., 1971).

Concentration factors for various marine organisms for several elements including heavy metals are given in Table 7. It can be seen that these factors range up to more than a million or more for the heavy metals. Concentration factor is defined as "the ratio of the concentration of an element or radionuclide in an organism or its tissues to that

TABLE 7: Ranges of Element Concentration Factors[a] in Marine Organisms at Various Trophic Levels[b]

	Algae		Grazers		Predators		
Element	Sessile	Plankton (Phytoplankton and Sargassum)	Plankton (Copepods, Pteropods, Salps, Doliolid)	Shellfish	Plankton [Euphausiids, Planktonic Amphipods, Shrimp (Acanthephyra, Paleomonetes)]	Fish	Squid
Ag	(18) 100-1,000	(1) $<100-220$	(1) <100	(2) $330-2 \times 10^4$	(1) $<45-900$		(1) 900-3,000
Cd	(12, 13) 11-20	(1) $<350-6,000$	(1) $<80-10^5$	(2) $10^5-2 \times 10^6$	(1) $<300-10^4$	(12) >10	(1) 2,800
Ce	(14) $100-3,300^c$	(4) $2,000-4,500^c$		(14) $40-300^c$		(14) $5-12^c$	
Co	(13, 14, 16) 15-740	(1, 13, 17) 75-1,000	(1) $<110-10^4$	(7) 24-260– (14) 18^c	(1) $<70-1,300$	(14) 28-560	(1) $<200-5 \times 10^4$
Cr	(14) 100-500	(1) $<70-600$	(1) $<15-10^4$	(2) $6 \times 10^4-3 \times 10^5$	(1) $<55-3,900$	(8) 3-30	(1) <70
Cs	(14) 16-50	(14) 16-22	(3) $6-15^c$	(14) $3-15^c$		(14) 6-10	
Fe	(14) $10^3-5 \times 10^3$	(1) $750-7 \times 10^4$	(1) $440-6 \times 10^4$	(2) $7 \times 10^4-3 \times 10^5$	(1) $3 \times 10^3-3 \times 10^4$	(14) $400-3 \times 10^3$	(1) $10^3-3 \times 10^3$
I	(14) $160-7 \times 10^3$			(14) 40-70		(14) 10	
Mo	(9, 16) 10-200	(1) $<3-17$	(1) 2-175	(2) 30-90	(1) $<2-14$	(9) ~200	(1) <10
Mn	(14) $20-2 \times 10^4$	(1, 14) $300-7 \times 10^3$	(1) $21-4 \times 10^3$	(2, 14) $3 \times 10^3-6 \times 10^4$	(1) 270-1,600	(14) $95-10^5$	(1) 10^3
	(13, 16)	(1)	(1)	(2)	(1)		(1)

Table 7 (continued)

Ni	$50-10^3$	$25-300$	$2-10^3$	$4\times10^3-10^4$	$17-90$		$30-90$
Pb	(13) $8\times10^3-2\times10^4$	(1, 17) $<10^3-3\times10^6$	(1) $3\times10^3-2\times10^6$	(2, 6) $39-5\times10^3$	(1, 15) $200-6\times10^4$	(10) $5-10^4$	(1,15) $100-2\times10^5$
Ru	(14) $100-10^{3c}$			(14) $1-16^c$	(11) 10^c	(14) 10^c	
	(18) $<200-1,200$	(1) <200	(1) $<10-6\times10^3$		(1) $<160-2,400$		(1) $<400-2,100$
Sr	(14) $0.1-90$	(1) $0.9-54$	(1) $1-85$	(5) $\sim50^c$	(1) $1.2-10$	(14) $4-5$	(1) $0.9-1.2$
Ti	(15) $200-3\times10^4$	(1) $600-10^4$	(1) $28->3\times10^4$		(1) $110-2\times10^4$		(1) $300-3,000$
Zn	(14, 16) $80-3,000$	(1) $200-1,300$	(1) $125-500$	(2, 14) $1,400-10^5$	(17) ~50	(14) $280-2\times10^4$	(1) $2,500$
Zr	(14) $200-3,000^c$	(1) $<1,000-2\times10^4$	(1) $360-3\times10^4$	(14) $8-36^c$	(1) $<800-4\times10^4$	(14) 5^c	(1) 2×10^4

---

[a] Concentration in whole, fresh organism versus concentration in seawater (see Chapter 5)

[b] Literature references are shown in parentheses in upper left of box and listed below. No attempt has been made to achieve completeness; the ranges of concentration factors are for illustration, but are believed to be representative.

[c] Concentration from radionuclide tracer experiments.

(1) Bowen *et al.*, unpublished, some data from Nicholls *et al.*, 1959.
(2) Brooks and Rumsby, 1965.
(3) Bryan, 1963.
(4) Chipman, 1958.
(5) Cigna *et al.*, 1963.
(6) Costa and Molina, 1957.
(7) Fukai, 1968.
(8) Fukai and Broquet, 1965.
(9) Fukai and Meinke, 1962.
(10) Goldberg, 1962.
(11) Hiyama and Khan, 1964.
(12) Hiyama and Shimizu, 1964.
(13) Ishibashi *et al.*, 1964.
(14) Polikarpov, 1966.
(15) Tamotsu *et al.*, 1964.
(16) Young and Langille, 1958.
(17) Vinogradova and Kovalskiy, 1962.
(18) Black and Mitchell, 1952.

From Lowman et al. (1971)

concentration directly available from the organism's environment under equilibrium or steady-state conditions" (Lowman et al., 1971). However, marine organisms accumulate heavy metals and other elements from many sources including food, water, suspended particles and deposited sediments. Therefore, the concentration factors listed should be viewed as indicators that can be changed by biological and environmental factors.

Absorption from solution through the gills of the lobster *Homarus vulgaris* results in a concentration of 7ppm of zinc in the lobster blood flowing through the gills, or 10^3 to 10^4 times the concentration in sea water. Before the zinc diffuses through the gill epithelium probably attached to proteins, zinc is first adsorbed onto the cuticle covering of the gills (Bryan, 1971). Anderson et al. (1974) summarized recent studies of heavy metal uptake from sea water in marine animals as follows:

> Among the more recent studies, Eisler et al. (1972) have shown that mummichogs or common killifish, *Fundulus heteroclitus*, scallops, *Aquipecten irradians*, oysters, *Crassostrea virginica* and northern lobsters, *Homarus americanus*, exposed for 21 days to flowing sea water containing 10 µg/L (ppb) of cadmium accumulated the metal to levels equivalent to 45, 114, 352 and 41 percent, respectively, higher per unit wet weight than baseline levels of cadmium in the controls. Pentreath (1973) determined that exposure of the estuarine mussel, *Mytilus edulis* to zinc, manganese, iron and cobalt in sea water solution for 49 days resulted in maximum concentration factors of approximately 500, 250, 5000, 1000 respectively. Vernberg and O'Hara (1972) studied the effects of temperature-salinity stress on mercury uptake and accumulation in the gill and hepatopancreas tissues of the fiddler crab *Uca pugilator* and found significant uptake over 72 hours of exposure, with gill tissue accumulating greater amounts than hepatopancreas under all conditions.

The NSF/IDOE (National Science Foundation/International Decade of Ocean Exploration) Pollutant Transfer Workshop reported on more recent findings of heavy metal uptake by marine organisms. The Skidaway group at the University of Georgia found that the marine plant *Spartina alterniflora* takes up mercury through its roots. Subsequently, the mercury is transferred to the leaves and then released to estuarine waters. The root system apparently concentrates inorganic mercury, while the leaves concentrate methylmercury (NSF/IDOE, 1974). Eelgrass (*Zostera marina*) in the coastal waters of Alaska absorb trace metals from the water and sediments and concentrate zinc, copper and cadmium in their roots, rhizomes and leaves. The eelgrass helps to recycle these trace elements in the food web that would normally be lost to the sediments (NSF/IDOE, 1974).

At the California Institute of Technology it has been discovered that the form of the heavy metal lead in sea water is critical to the knowledge of its behavior in the food chain. For example, the investigators found that much of the lead in sea water may be adsorbed on the mucilage of algae (NSF/IDOE, 1974). This is consistent with the findings of Glooschenko (1969) discussed earlier for the marine diatom *Chaetoceros costatum*. Chow, Patterson and Settle (1974) have also discovered that excessive amounts of lead collect on the epidermal mucous of fish. These observations are important since the biologically active fraction of lead in marine organisms might be small compared to the large amounts of biologically inactive adsorbed lead on these organisms. This distinction has often been ignored in the past (NSF/IDOE, 1974).

The path of uptake can also depend on the element itself. Bryan (1964) found that zinc and copper were absorbed indirectly from the water into the lobster *Homarus vulgaris*, while Bryan and Ward (1965) discovered that manganese uptake was mostly from food for the same species of lobster. Pentreath (1973) investigated uptake of radioisotopes of zinc, manganese, cobalt and iron by the mussel *Mytilus edulis* and reported that accumulation from sea water was minor compared to food accumulation. Pentreath indicated that uptake was from food particles as well as from mucous accumulation of metals in soluble form. Results of Hoss (1964) as reported by Bryan (1971) using zinc-65 in the flounder, *Paralychthys*, suggest that food is a more important source of zinc than sea water. Likewise, Preston and Jeffries (1969, as cited by Bryan, 1971) have shown that zinc and cobalt are absorbed from ingested particles through the gut rather than from sea water solution for the oyster *Ostrea edulis*.

In contrast, Polikarpov (1966) contends that chemical mineral substances are more generally accumulated directly from water than indirectly through the food chain. According to Lowman et al. (1971) the degree to which a trace element is taken up in a marine organism depends on the relative concentrations of the element in the water and food. When an element is concentrated in food only slightly above its concentration in water, the food supplies a relatively low fraction of the element for marine organisms. However, when the element is highly concentrated in food compared to sea water, a major fraction of the element may be accumulated from the food through the gut. The relative importance of uptake of heavy metals from water compared to uptake from food is still being studied and is by no means resolved for marine organisms. As mentioned above, it probably varies for different elements and organisms as well as for various relative concentrations.

Bryan (1973) reported a seasonal variation in the concentrations of trace metals in two scallop species from the English Channel. Variations between species were observed, but the highest values of metals occurred in the autumn and winter when phytoplankton productivity was low, while the values decreased when phytoplankton production increased. The metals looked at were Ag, Co, Cr, Cu, Mn, Ni, Pb, Zn, Al, Cd and Fe and they were concentrated in the kidneys and digestive glands to the greatest extent. Bryan reasoned that the seasonal variation was due to three factors:

1) More food from increased phytoplankton productivity in spring and summer results in increased metabolic activity for the scallop and increased excretion of wastes, including excess heavy metals.
2) The uptake of metals by phytoplankton decreases the concentration in the water. Also extracellular products from the phytoplankton may chelate metals in the water thereby reducing their availability to the scallops.
3) In the times of high productivity, the amount of metal/phytoplankton cell decreases, since the cell members increase and the metal concentrations remain virtually the same.

Other organisms besides particle feeders like the scallops probably have seasonal variations in their uptake of heavy metals, although there has been little investigation to date of this environmental variable.

Storage and Metabolism

Once heavy metals are taken up by marine organisms they are usually used in enzyme systems or stored in a particular body tissue, sometimes for just a temporary period. The place of storage in the organism and its subsequent pathway through the organism is dependent on several variables including the type of metal, the form of the metal complex, the method of uptake, species and the age of the organism. In general, elements that are concentrated in marine organisms can be grouped into one of five categories: 1) structural elements - carbon, nitrogen, phosphorus (silicon, calcium and strontium, in some cases); 2) catalyst elements - iron, copper, zinc, manganese, and cobalt (nickel, chromium, cadmium and silver may follow these elements); 3) elements easily hydrolyzed at sea water pH; 4) heavy halogens; and 5) heavy divalent ions - barium, radium and lead (Lowman et al., 1971). Most of the heavy metals of concern occur in the catalyst element group.

Different groups of marine organisms are able to accumulate and store heavy metals in their tissues depending on their ability to regulate the concentration in their body compared to the environmental concentration. This involves not only uptake and storage of heavy metals but also release of the metals back to the environment. For example, according to Bryan (1971) when the concentrations of metals such as zinc or copper in sea water are increased, the concentrations in oysters increase appreciably while the concentrations in the flesh of crustaceans such as crabs or lobsters remain relatively constant. Storage sites for most organisms include the digestive glands, muscle tissue, skeletal tissue and gills.

For small marine crustaceans (*Euphausia pacifica, Thysanoessa spinifera, Pandulus stenolepis* and *P. platyceros*) Fowler et al. (1970) found that zinc-65 fed through a food chain accumulated primarily in the interstitial spaces between muscle fibers, in the eye, within the exoskeleton and on the interior surface of the exoskeleton. These locations were the same as those for storage of zinc-65 from water absorption processes. However, the source of the zinc affected the saturation levels of the tissues. When uptake was from food, the muscle tissue (and hepatopancreas at times) contained a higher percentage of the total zinc level in shrimps and euphausiids than the exoskeleton. When uptake was from water, the percentage of total zinc level was higher in the exoskeleton. The fact that a significant percentage of zinc was located in the exoskeleton from labelled food uptake suggests that the zinc was transported rapidly by the haemolymph from the gut to the exoskeleton (Fowler et al., 1970). The investigators concluded that since most of the zinc-65 was located between cells rather than inside of cells, most ingested zinc apparently accumulates in excess of the animals' needs and is not used metabolically.

In other marine crustaceans primary storage has been found to occur in the hepatopancreas for excess zinc in lobster blood and for excess copper in the shrimp *Crangon vulgaris* (Bryan, 1971). Another crustacean, the fiddler crab *Uca pugilator*, concentrated mercury primarily in the gill tissues with lesser amounts in the hepatopancreas and green gland. Very small amounts were found in the carapace and muscle tissues (Vernberg and Vernberg, 1972). See Figure 5. The mode of uptake by the crab, however, was absorption of mercury from sea water.

Molluscs accumulate heavy metals in the digestive glands and kidneys primarily (Bryan, 1971; Bryan, 1973; Pentreath, 1973). Anderlini (1974) discovered high concentrations of cadmium (up to 1400 ppm) in the digestive glands of the red abalone *Haliotis rufescens* from samples along the California coast. He looked at eight heavy metals (silver, cadmium, chromium, copper, lead, mercury, nickel and zinc) and reported varying concentrations in the gills, mantle, digestive gland and foot muscle. The concentrations in the different tissues varied with the metal type, the concentrations of the metal in the sea water and the method of uptake. For example, nickel had the highest concentrations in the gill (up to 100 ppm), more than 2-3 times the nickel levels in other tissues. This was probably due to absorption and accumulation of nickel into the mucous sheets of the gills as well as absorption by the gills themselves (Anderlini, 1974). An investigation of several heavy metals in North Atlantic finfish revealed that muscle tissue of these Osteichthys species concentrated arsenic, cadmium, copper, mercury and zinc in varying amounts. Mercury and cadmium concentrations in muscle tissues of Chondrichthys species studied tend to be higher than those of Osteichthys while arsenic concentrations were definitely higher. The liver of Chondrichthys had higher concentrations of arsenic, cadmium, copper and zinc compared to other Chondrichthys tissues (Windom et al., 1973a). Silver, cadmium, chromium, copper, nickel, lead and zinc concentrate mainly in the gonads and liver of the Dover sole with smaller amounts in the epidermis. Specimens were taken from outfall and control areas off Southern California (SCCWRP, 1974). Chow et al. (1974) found lower concentrations of lead in tuna muscle than had been reported previously. Muscle tissue contained about 0.003 ppm of lead while epidermis had about 2 ppm in wet tissue. High concentrations in fish fins from tuna is due to the mucin secreted by the mucous cells of the epidermis which forms a mucous slime from a glycoprotein. The authors conclude that it is likely that strong heavy metal complexing sites in the proteins take up lead from sea water and incorporate it into the slime. They conclude that most of the lead in time is probably contained in this epidermal mucous layer and that it is unlikely that much lead passes through the skin barrier from sea water (Chow et al., 1974). Analysis of epidermal mucous and kidneys from an adult sculpin (*Scopaena guttata*) exposed to large concentrations of lead acetate over three months resulted in accumulation of lead in the mucous. The lead did not increase in the muscle tissue, but did increase in the kidney and bone. Apparently the kidney is metabolizing the accumulated lead and some of it is deposited in the bone (NSF/IDOE, 1974).

Evidence that the form of the metal compound is important for the storage site derives from observations of 70% of the total mercury in carnivorous fish muscle occurring as methymercury. For invertebrate omnivores, the percentage of methylmercury is less. Samples of liver and spleen from sharks contained low amounts of methylmercury compared to total mercury (NSF/IDOE, 1974). At the cellular level, the distribution of lead-210 in sea cucumber embryos (*Strongylocentrotus purpuratus*) has been investigated by Nash (1975). He reported that embryos can absorb significant amounts of lead from levels as low as 4.81 x 10^{-6} ppm., Most of the absorbed lead was concentrated in the nuclear portion of the cell homogenate.

All of these investigations indicate that there are many variables involved in the storage and metabolism of heavy metals in marine organisms. At present little is still known about the pathways of uptake, metabolism, storage and release of heavy metals and their transport through the marine ecosystems.

Discharge and Release into the Marine Environment

There have been few studies to date of the release or depuration of heavy metals from marine organisms to the marine environment. Although data on retention times are scanty, there are indications that metals concentrated in animal tissues are retained at significant concentrations for several months (Andersen et al., 1974). Discharge of heavy metals from marine organisms can take place by ion exchange across cell membranes of gill and body surfaces, loss by molting exoskeletons that have concentrated heavy metals, excretion of heavy metals into the gut and loss by feces and excretion in the urine. All of these processes help an organism to regulate the concentration of heavy metals and other substances accumulated from sea water or food, but the extent and rate of their release is poorly known for heavy metals.

Bryan (1971) reports that excretion of metals across the gills appears to occur: in the shore crab, *Carcinus maenas*, and in the rainbow trout, *Salmo gairdnerii*. The cypiid larva of the barnacle, *Balanus amphitrite niveus*, excretes excess copper into the lumen of the gut and the octopus, *Octopus dofleini*, excretes both copper and zinc into the rectal fluid. Crustaceans can excrete copper, zinc, cobalt, manganese and mercury in the urine. Little information is known about excretion of heavy metals from fish except that excretion of zinc in the urine of the rainbow trout is relatively unimportant (Bryan, 1971). The rate of loss of methyl mercury from species of carnivorous fish is very slow. Methyl mercury in fish has a half-life of about two years according to Miettinen et al. (1971, as cited by Hartung, 1972).

A long-term experiment concerning the elimination of zinc-65, cesium-137 and cerium-144 by euphausiid shrimps determined that approximately 96% of the initial body concentration was eliminated over a five month period (Fowler et al., 1971). The biological half-life of ^{65}Zn was 140 days, and the percentage of ^{65}Zn lost in molts compared to the total in the organism was 1%. Assuming that loss through fecal pellets is small, the major mechanism for ^{65}Zn loss for euphausiids would be isotopic exchange with the water. From Figure 5 it can be observed that approximately 90% of the ^{65}Zn was lost after 30 days.

In a study of the mussel, *Mytilus edulis*, and its accumulation of some heavy metal isotopes from sea water, Pentreath (1973) observed that the greatest accumulation was in the stomach and digestive gland for all isotopes. However, after two weeks iron-59 occurred in the mussel foot in the byssus gland area that attaches the mussel to the substrate. Following another two week period, the iron-59 clusters disappeared. The author postulated that the iron might be secreted into new byssus threads. After 42 days in filtered sea water, the loss of the metals from the stomach and digestive gland was as follows:

	Zinc	Manganese	Iron
% loss in dry weight from stomach and digestive gland	23.1	14.3	52.2

There was no loss from the adductor muscle (Pentreath, 1973). Young and Folsom (1967, as cited by Pentreath, 1973) recorded a long half-life for zinc-65 in the mussel, *Mytilus californianus*, of 76 ± 3.5 days.

Other observations of release of heavy metals by molluscs include a biological half-life of 193 days for manganese excretion from scallops (Bryan, 1973). No appreciable decrease in the concentrations of cadmium and zinc in dog whelps and limpets was found in the Bristol Channel after seven weeks and three weeks cleansing in clean sea water. A crab (*Carcinus maenas L.*) lowered its zinc concentration significantly but not the cadmium concentration after seven weeks cleansing (Peden et al., 1973).

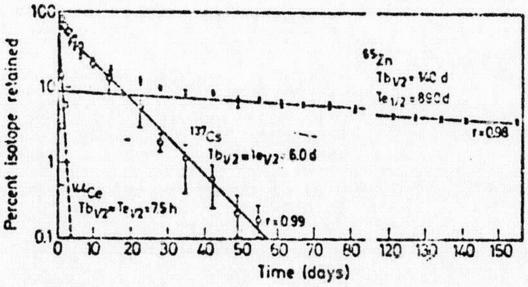


Fig. 5. *Euphausia pacifica*. Loss of 3 radionuclides from similar-sized euphausiids (Mean dry weight 2.4 mg). ^{65}Zn, n = 3; ^{137}Cs, n = 5; ^{144}Ce, n = 2; r: correlation coefficient. Bars indicate ranges of animal activity. All data were corrected for physical decay of the isotope except ^{137}Cs. Tb$_{1/2}$: biological half-life; Te$_{1/2}$: effective half-life; T: 10 °C. d: days

From Fowler et al. (1971)

Therefore, from these few investigations one can find evidence that marine organisms can release heavy metals back to the environment, but the time of release is relatively long. There is some evidence to indicate that molluscs may not be able to regulate heavy metal concentrations in their tissues as well as crustaceans (Bryan, 1971). However, it is not known if this difference is due to separate pathways of uptake and storage, different methods of release or differences in the bonding of the metals and their complexes in the tissues.

Food Web Magnification

There is ample evidence to indicate that heavy metals accumulate in the marine food web in a variety of organisms at various trophic levels and through a variety of uptake pathways. As can be seen from the preceding discussion, heavy metals can be concentrated by absorption across gills, body surfaces and gut walls; adsorption into organisms, suspended and deposited particles; and taken up from food sources. The concentration factors listed in Table 9 reflect tremendous abilities for marine organisms to concentrate elements from very dilute solutions in sea water. However, as mentioned previously the significance of the concentration factors is observed by the many variables and pathways involved in the uptake of heavy metals by marine organisms. Classical food web magnification, or the increasing concentrations of an element per weight of tissue in successively higher trophic levels, for heavy metals is complicated by not only the various uptake pathways but also by the ability of some organisms to release the heavy metals back to the marine environment eventually and therefore regulate concentrations in their tissues against environmental gradients. The whole process is just not well enough understood at this time.

Most of the characteristics of heavy metals in the marine environment favor their magnification in the food web. Like PCB's and synthetic chemicals, heavy metals are relatively resistant to chemical and biological degradation. Evidence has been presented that the half-life of metals in tissues is relatively long before being excreted. The half-life can range up to two years for methylmercury compounds in fish. The longevity of the metals in tissues and the high concentration factors of many marine organisms suggest that food web magnification can take place. Most of the incidents of high levels of heavy metals found in marine organisms in the ocean occur in coastal waters and point sources near pollution sources from land. A toxic effect on a consumer in the higher levels of the marine food web, including man, can result from feeding on organisms further down in the food web that have concentrated heavy metals at levels that have no apparent effect on the food organism.

Besides the much publicized occurrence of mercury compounds in high concentrations in some tuna and swordfish, heavy metals such as arsenic, cadmium, copper, zinc, chromium, lead, nickel and silver have been reported in various organisms from the marine environment throughout the world (LeBlanc and Jackson, 1973; Stenner and Nickless, 1975; Peden et al., 1973; Stenner and Nickless, 1974; Anderlini, 1974; Windom et al., 1973a; Windom et al., 1973b; Chow et al., 1974; and Bryan, 1973). In a study of mercury in plankton in the North Atlantic, Windom et al. (1973b) reported concentrations of less than 0.2 to 0.4 ppm in open ocean plankton compared to 5.3 ppm in nearshore plankton in polluted areas. The samples included mostly copepods and arrow worms with eleven samples containing phytoplankton.

The authors hypothesized that the mercury was possibly transported from the nearshore plankton to the open ocean food web rather than through direct transport in the water since the dilution factors over the distances involved would be tremendous.

In a related study from the same area in the higher levels of the food web, Windom et al. (1973a) analyzed several heavy metals in various species of fin fish. In this investigation they found no tendency for onshore-offshore differences in concentrations for Osteichthys or Chondrichthys. There were differences in levels of accumulation and storage places for different metals in both groups as mentioned previously in this discussion. For Osteichthys arsenic concentrations ranged from less than 1.0 to 6.4 mg/g (ppm) and mercury concentrations from 0.1 to 3.0 mg/g. However, what is significant is that copper, cadmium and zinc concentrations were similar in all fish studied except for the smaller plankton-eating fish (anchovies and myctophids) which had much larger concentrations of these metals than the other fishes. This would suggest depletion of these metals up the food chain, and not magnification, since the plankton on which these fish feed have an even higher concentration of these metals (Windom et al., 1973a).

A similar instance of food chain accumulation, but not magnification, could be found in predators of the red abalone, *Haliotis rufuscens*, off the California coast. Anderlini (1973) reported a high concentration of cadmium (up to 1400 ppm) in the digestive glands of the red abalone. However, cadmium levels in the kidneys of mollusc-eating sea otters (*Enhydra lutris*) off the California coast ranged from 89 to 300 ppm. Although this was higher than cadmium in fish-eating sea lions (from 18 to 63 ppm) from a comparable level in the food web, the point is that the cadmium levels did not approach those found in the abalone. Therefore, the cadmium was probably accumulated in the food chain, but classical magnification probably does not take place. Whether or not the levels of cadmium were increased in the next trophic level, the large amounts of cadmium in the higher level predators would be cause for concern. Other marine mammals, birds, fish and man at the upper levels of the marine food web can be affected by high concentrations of certain heavy metals accumulated in the food web.

What does this mean for heavy metals introduced into the ocean from offshore petroleum operations? Evidence has been presented that heavy metal concentrations in petroleum, formation waters and drilling fluids can range from 10 to 10^5 times the natural background levels of the open ocean (see Tables 4-8). Therefore, events such as accidental massive or chronic oil spills, accidental loss of drilling fluids and the discharge of formation waters can introduce higher loads of heavy metals into the ocean. The introduced metals are then diluted by sea water, precipitated out, adsorbed on particles or other organisms and absorbed by some marine organisms to various degrees. These discharges would be localized sources occurring around drilling platforms for the most part.

Therefore, there could be some uptake of metals especially by the sessile organisms around the platforms. It is not known to what extent this occurs and to what levels the heavy metals would concentrate in the water column, sediments or marine organisms as a result of petroleum operations. The only investigation conducted so far concerning effects of heavy metals from offshore petroleum operations indicated that the concentration ranges of heavy metals in the water column was within the ranges for the metals in open ocean water except for barium where the data was inconclusive and a zinc gradient around the platforms probably due to the decomposition of the sacrificial covering of the platform legs (GURC, 1974).

The input of heavy metals to the marine environment and accumulation in the food web due to offshore petroleum operations should be far less significant than sources of heavy metals from land in most coastal waters such as river runoff, sewage effluent and industrial wastes. Since the effects of heavy metal input from offshore petroleum operations into the marine food web are largely unknown, it is advisable to continue to observe and monitor the marine environment for possible accumulation in the food web.

References

Ahearn, D. G., and S. P. Meyers, eds. 1973. The microbial degradation of oil pollutants. Workshop held at Georgia State University, Atlanta, December 1972. Publ. No. LSS-SG-73-01. Center for Wetland Resources, Louisiana State University, Baton Rouge. 322 pp.

Alyakrinskaya, I. O. 1966. Behavior and filtering ability of the Black Sea *Mytilus galloprovincialis* on oil polluted water. Zool. Zh. 45(7): 998-1003; also in Biol. Abstr. 48(14):6494.

Anderlini, V. C. 1974. The distribution of heavy metals in the red abalone *Haliotis rufescens* on the California coast. Arch. Environ. Contam. & Toxicol. 2(3):253-265.

Anderson, J. W. 1973. Uptake and depuration of specific hydrocarbons from fuel oil by the bivalves *Rangia cuneata* and *Crassostrea virginica* pp. 690-708. In Background papers, workshop on petroleum in the marine environment. National Academy of Sciences, Washington, D.C.

_______________, R. C. Clark, Jr. and J. J. Stegeman. 1974. Contamination of marine organisms by petroleum hydrocarbons. In Proceedings of Bioassy Workshop sponsored by the Marine Technology Society, Montauk, Long Island, April 9-11, 1974.

_______________ and J. M. Neff. 1974. Accumulation and release of petroleum hydrocarbons by edible marine animals. Submitted to an International Symposium entitled Recent Advances in the Assessment of the Health Effects of Environmental Pollution, Paris, June, 1974.

_______________, J. M. Neff and S. R. Petrocelli. 1974. Sublethal effects of oil, heavy metals and PCB's on marine organisms. In the Mechanisms of Survival of Toxic Environments, Academic Press.

Atlas, R. M., and R. Bartha. 1972a. Degradation and mineralization of petroleum in sea water. Biotech. Bioeng. 14:297-318.

_________________________. 1972b. Biodegradation of petroleum in sea water at low temperature. Can. J. Microbiol. 18:1851-1855.

Battelle Memorial Institute. Pacific Northwest Laboratories. 1970. Review of Santa Barbara Channel oil pollution incident. Wat. Pollut. Control Res. Ser., (Dist 20).

_________________________. 1967. Oil spillage study; literature search and critical evaluation for selection of promising techniques to control and prevent damage. U. S. Dep. Commer., Clgh. Fed. Sci. Tech. Inf., Springfield, VA 22151.

Blumer, M. 1969. Oil pollution of the ocean. In: Oil on the Sea, P. Hoult (editor), Plenum Press, New York, p. 5-13.

__________, P. C. Blokker, E. B. Cowell, D.F. Duckworth. 1972. Chapter 2, Petroleum. In: A Guide to Marine Pollution. E. D. Goldberg (editor). Gordon and Breach Science Publishers, New York.

__________, J. C. Robertson, J. E. Gordon and J. Sass. 1969. Phytol-derived C^{19} di- and triolefinic hydrocarbons in marine zooplankton and fishes. Biochemistry 8, 4067-4074.

__________, and J. Sass. 1972a. The West Falmouth oil spill. Woods Hole Oceanographic Institution Tech. Rep. 72:19. Woods Hole, Mass. 125 pp.

____________________. 1972b. Oil pollution: persistence and degradation of spilled fuel oil. Science 176:1120-1122.

__________, G. Souza and J. Sass. 1970. Hydrocarbon pollution of edible shellfish by an oil spill. Mar. Biol. 5, 195-202.

Borneff, J., F. Selenka, H. Kunte and A. Maximos. 1968. Experimental studies on the formation of polycyclic aromatic hydrocarbons in plants. Environmental Research 2, 22-29.

Brown, R. A., T. D. Searl, J. J. Elliott, B. G. Phillips, D. E. Brandon, and P. H. Monaghan. 1973. Distribution of heavy hydrocarbons in some Atlantic Ocean waters. p. 505-519. In Proceedings, Joint Conference on Prevention and Control of Oil Spills. American Petroleum Institute, Washington, D.C.

Browning, E. 1953. Toxicity of industrial organic solvents. Medical Research Council, Industrial Health Research Board Rep. No. 80, rev. ed. H. M. Stationery Office, London.

Bryan, G. W. 1964. Zinc regulation in the lobster *Homarus vulgaris*. I. Tissue zinc and copper concentrations. J. Mar. Biol. Ass. U.K. 44(3):549-563.

__________. 1971. The effects of heavy metals (other than mercury) on marine and estuarine organisms. Proc. Roy. Soc. Brist. 177:389-410.

__________. 1973. The occurrence and seasonal variation of trace metals in the scallops *Pecten maximus (L.)* and *Chlamys opercularis (L.)*. J. Mar. Biol. Ass. U.K. 53:145-166.

__________, and E. Ward. 1965. The absorption and loss of radioactive and nonradioactive manganese by the lobster *Homarus vulgaris*. J. Mar. Biol. Ass. U.K. 45(1):65-95.

Bryant, W. J., J. R. Goldburn and S. E. Hrudey. 1974. Water pollution aspects from waste drilling mud disposal in Canada's Arctic. Offshore Technology Conference Preprints, Paper No. OTC 2044, May 6-8, 1974, Houston.

Carlson, G. P. 1972. Detoxification of Foreign Compounds by the quahaug, *Mercenaria mercenaria*. Comp. Biochem. Physiol. 43B, 295-302.

Chow, T. J., C. Patterson and D. Settle. 1974. Occurrence of lead in tuna. Nature, 251(5471):159-161.

Clark, R. C. Jr. and J. S. Finley. 1974. Uptake and loss of petroleum hydrocarbons by mussels (*Mytilus edulis*) in laboratory experiments (in preparation).

Conover, R. J. 1971. Some relations between zooplankton and Bunker C oil in Chedabucto Bay following the wreck of the tanker Arrow. J. Fish. Res. Board Can. 28:1327-1330.

Cox, B. A. and J. W. Anderson. 1974. Unpublished results. (In Anderson et al. 1974).

Davis, J. B. 1967. Petroleum Microbiology. Elsevier, Amsterdam. 605 pp.

DiSalvo, L. H., H. E. Guard and L. Hunter. 1975. Tissue hydrocarbon burden of mussels as potential monitor of environmental hydrocarbon insult. Environmental Science and Technology, Vol. 9, p. 247-251.

Ehrhardt, M. 1972. Petroleum hydrocarbons in oysters from Galveston Bay. Environ. Pollut. 3, 257-271.

Eisler, R. G. E. Zaroogian and R. J. Hennekey. 1972. Cadmium uptake by marine organisms. J. Fish. Res. Bd. Can. 29:1367-1369.

Filby, R. H. and K. R. Shah. 1971. Mode of occurrence of trace elements in petroleum and relationship to oil spill identification methods. In Proceedings Am. Nuclear Society Meeting: Nuclear Methods in Environmental Research, J. R. Vogt, T. F. Parkinson and R. L. Carter (eds.), Univ. of Missouri.

Fowler, S. W., L. F. Small and J. M. Dean. 1970. Distribution of ingested zinc-65 in the tissues of some marine crustaceans. F. Fish. Res. Bd. Can. 27:1051-1058.

________________________________. 1971. Experimental studies on elimination of zinc-65, cesium-137 and cerium-144 by euphausiids. Mar. Biol. 8(3):224-231.

Friede, J., P. Guire, R. K. Gholson, E. Gaudy, and A. F. Gaudy. 1972. Assessment of biodegradation potential for controlling oil spills on the high seas. Project Rep. No. 4110.1/3.1. Department of Transportation, U.S. Coast Guard, Office of Research and Development, Washington, C.C. 130 pp.

Gerarde, H. W. and D. F. Gerarde. 1961. The ubiquitous hydrocarbons. Assn. Food Drug Officials United States, 25-26, 1-47.

Glooschenko, W. A. 1969. Accumulation of ^{203}Hg by the marine diatom *Chaetoceros costatum*. J. Phycol. 5:224-26.

Goldacre, R. J. 1968. Effect of detergents and oil on the cell membrane. In: The Biological Effects of Oil Pollution on Littoral Communities. Suppl. to Vol. 2 of Field Studies, Field Studies Council, London. J. D. Carthy and Don R. Arthur (editors), 131-317.

Goldberg, E. D. 1965. Minor elements in sea water. In: Chemical Oceanography, J. P. Riley and G. Skivrow (editors), Academic Press, New York, p. 163-196.

________________, W. S. Broecker, M. G. Bross and K. K. Turekian. 1971. Marine Environment, National Academy of Sciences, Washington, D.C. p. 137-146.

Gunkel, W. 1967. Experimentell--okolgische untersuchungen uber die limitierenden faktoren des microbiel en olabbaues im marinin milieu. Helgolander wiss. Meeresunters. 15:210-225.

__________. 1968. Bacteriological investigations of oil-polluted sediments from the Cornish coast following the Torrey Canyon disaster, pp. 151-158. In E. B. Cowell, ed. The Biological Effects of Oil Pollution on Littoral Communities. Suppl. to Field Studies, No. 2. Institute of Petroleum, London.

GURC (Gulf Universities Research Consortium). 1974. The offshore ecology investigation: final project planning council consensus report. GURC report No. 138, Galveston, Sept. 20.

Hartung, R. 1972. Biological effects of heavy metal pollutants in water. In Metal Ions in Biological Systems, S. K. Dhar (ed.), Plenums Publishing Company, New York, p. 161-172.

Hoss, D. E. 1964. Accumulation of zinc-65 by flounder of the genus *Paralichthys*. Trans. Am. Fish. Soc. 43:364-368.

IDOE. 1972. Baseline studies of pollutants in the marine environment. International Decade of Oceanographic Exploration Workshop, Brookhaven, May.

Klug, M. J. and A. J. Markovetz. 1971. Utilization of aliphatic hydrocarbons by microorganisms, pp. 1-43. In A. H. Rose and J. F. Wilkinson, eds. Advances in Microbial Physiology, Vol. 6 Academic Press, New York.

Lee, R. A. and A. A. Benson. 1973. Fate of petroleum in the sea--Biological aspects, pp. 541-551. In Background papers, workshop on petroleum in the marine environment. National Academy of Sciences, Washington, D.C.

__________, R. Sauerheber, and A. A. Benson. 1972a. Petroleum hydrocarbons: Uptake and discharge by the marine mussel, *Mytilus edulis*. Science 177:344-346.

__________________________, and G. H. Dobbs. 1972b. Uptake, metabolism and discharge of polycyclic aromatic hydrocarbons by marine fish. Mar. Biol. 17:201-208.

LeBlanc, P. J. and A. L. Jackson. 1973. Arsenic in marine fish and invertebrates. Mar. Poll. Bull. 4(6):88-90.

Lowman, F. G., T. R. Rice and F. A. Richards. 1971. Accumulation and redistribution of radionuclides by marine organisms. In Radioactivity in the Marine Environment, National Academy of Sciences, Washington, D.D. p. 161-199.

Menzel, R. W. 1955. Some phases of the biology of *Ostrea equestris* Say and a comparison with *Crassostrea virginica* (Gmelin). Pub. Inst. Mar. Sci., Univ. Tex. 4:69-153.

Miettinen, V., E. Blankenstein, K. Rissanen, M. Tillander, J. K. Miettinen and M. Valtonan. 1970. FAO Tech. Conf. on Marine Pollution, Rome, Italy, Dec. 9-18.

Mitchell, R., S. Togel, and I. Chet. 1972. Bacterial chemoreception: An important ecological phenomenon inhibited by hydrocarbons. Water Res. 6:1137-1140.

National Academy of Sciences. 1975. Petroleum in the marine environment. Washington, D.C. 107 pp.

Nash, W. W. 1975. Cellular distribution of lead in *Strongylocentrotus purpuratus*. In Abstracts of Program, Southern California Academy of Sciences Annual Meeting, Los Angeles, May 9-10.

NSF/IDOE (National Science Foundation/International Decade of Ocean Exploration). 1974. Pollutant Transfer to the Marine Environment. Deliberations and recommendations of the NSF/IDOE Pollutant Transfer Workshop held in Port Aransas, Texas, January 11-12, 1974.

Operation Oil. 1970. Report of the task force- Operation Oil (Cleanup of the Arrow oil spill in Chedabucto Bay) to the Minister of Transport. Atlantic Oceano. Lab. Bendford Inst. Dartmouth, Nova Scotia.

Parker, Ca. A. 1970. The ultimate fate of crude oil at sea--uptake of oil by zooplankton. AML Rep. B. 198(M).

Parker, C. A. 1971. The effect of some chemical and biological factors on the degradation of crude oil at sea, pp. 237-244. In P. Hepple, ed. Water Pollution by Oil. Institute of Petroleum, London.

Pasteels, J. J. 1968. Pinocytose et athrocytos par Pepithelium branchial de *Mytilus edulis*. Z. Zellforsch. 92:239-259.

Pentreath, R. J. 1973. The accumulation from water of ^{65}Zn, ^{54}Mn, ^{58}Co, and ^{59}Fe by the mussel, *Mytilus edulis* J. Mar. Biol. Ass. U.K. 53:127-143.

Peden, J. D., J. H. Crothers, C. E. Waterfall and J. Beasley. 1973. Heavy metals in Somerset marine organisms. Mar. Poll. Bull. 4(1):7-9.

Polikarpov, G. G. 1966. Radioecdogy of aquatic organisms. Reinhold, N.Y. 314 p.

Powell, N. A., C. S. Sayce, and D. F. Tufts. 1970. Hyperplasia in enstarine bryozoan attributable to coal tar derivatives. J. Fish Res. Board Can. 27:2095-2096.

Preston, A. and D. F. Jeffries. 1969. Aquatic aspects in chronic and acute contamination situations. In Environmental Contamination by Radioactive Materials, IAEA, Vienna, p. 183-211.

Robertson, B., S. Arhelger, P. J. Kinney, and D. K. Button. 1973. Hydrocarbon biodegradation in Alaskan waters, pp. 171-184. In Ahearn and Meyers, eds., op. cit.

Roubal, W. T. 1973. In vivo and in vitro spin labeling studies of pollutant-host interaction. In F. J. Biros and R. Haque, eds. Proceedings, Symposium on Mass Spectrometry and NMR of Pesticides. Plenum Press, New York.

Scarratt, D. J. 1971. Incidence of Bunker C in common benthic animals and sediments. Contrib. Oil Pol Workshop. Nova Scotia Technical College. Halifax. p. 4-12.

SCCWRP (Southern California Coastal Water Research Project). 1974. Annual report for the year ended 30 June 1974. El Segundo.

Shipton, J., J. H. Last, K. E. Murray, and G. L. Vale. 1970. Studies on a kerosene-like taint in mullet (*Mugil cephalus*). II. Chemical nature of the volatile constituents. J. Sci. Food Agric. 21:433-436.

Stegeman, J. J. and J. M. Teal. 1973. Accumulation, release and retention of petroleum hydrocarbons by the oyster *Crassostrea virginica*. Mar. Biol. 22, 37-44.

_____________. 1974. Hydrocarbons in shellfish chronically exposed to low levels of fuel oil. Pollution and the Physiological Ecology of

Estuarine and Coastal Water Organisms. J. F. Vernberg, ed. Academic Press (to be published).

Stenner, R. D. and G. Nickless. 1974. Absorption of cadmium, copper and zinc by dog whelks in the Bristol Channel. Nature 247:198-199.

______________________________. 1975. Heavy metals in organisms of the Atlantic coast of S. W. Spain and Portugal. Mar. Poll. Bull. 6(6).

Straughan, D. and D. L. Lawrence. 1975. Investigation of ova cell hyperplasia in bryzoa chronically exposed to natural oil seepage. Water Air and Soil Pollution (in press).

Suess, E. 1972. Laboratory experimentation with 3, 4 benzpyrene in aqueous systems and the environmental consequences. Aus Wissenschaft und Praxis, Zentralbl. Bakt. Hyg. I. Abt. Orig B 155:541-546.

Tissier, M., and J. L. Oudin. 1973. Characteristics of naturally occurring and pollutant hydrocarbons in marine sediments, pp. 205-214. In Proceedings, Joint Conference on Prevention and Control of Oil Spills. American Petroleum Institute, Washington, D.C.

Traxler, R. W. 1973. Bacterial degradation of petroleum materials in low temperature marine environments, pp. 163-170. In Ahearn and Meyers, eds., op. cit.

Underwood, E. J. 1974. Factors influencing trace elements needs and tolerances in man. Mar. Poll. Bull. 5(6):86-88.

U. S. Department of Interior. 1975. Final Environmental Impact Statement for proposed 1975 Outer Continental Shelf oil and gas general lease sale offshore Southern California (OCS Sale No. 35).

Vale, G. L., G. S. Sidhu, W. A. Montgomery, and A. R. Johnson. 1970. Studies on a kerosene-like taint in mullet (*Mugil cephatus*). I. General nature of the taint. J. Sci. Food Agric. 21:429-432.

Vaughan, B. [illegible]973. Effects of oil and chemical dispersed oil on selected marine [illegible]iota -- A laboratory study. API Publ. #4191, Battelle Pacific Northwest Laboratories, Richland, Washington, 105 pp.

Vernberg, W. B. and J. O'Hara. 1972. Temperature-salinity stress and mercury uptake in the fiddler crab, *Uca pugilator*. J. Fish. Res. Bd. Can. 29:1491-1494.

______________ and J. Vernberg. 1971. The synergistic effects of temperature, salinity, and mercury on survival and metabolism of the adult fiddler crab, *Uca pugilator*. Fish. Bull. 70(2):415-420.

Whittle, K. J. and M. Blumer. 1970. Interactions between organisms and dissolved organic substances in the sea: Chemical attraction of the starfish *Asterias vulgaris* to oysters. In: Organic Matter in Natural Waters, D. W. Hood (editor), Inst. Mar. Sci., U. Alaska, Pub. No. 1, 495-507.

Windom, H., R. Stickney, R. Smith, D. White and F. Taylor. 1973. Arsenic, cadmium, copper, mercury, and zinc in some species of North Atlantic finfish. J. Fish. Res. Bd. Can. 30:275-279.

__________, F. Taylor, and R. Stickney. 1973. Mercury in North Atlantic plankton. J. Cons. Int. Explor. Mer. 35:18-21.

Yevich, P. P. and M. M. Barry. 1970. Histopathologic finding in molluscs exposed to pollutants. Abstract of papers, session III, section 4, 33d annual meeting. American Society of Limnology and Oceanography, URI, August 25-29.

Zitko, V. and W. V. Carson. 1970. The characterization of petroleum oils and their determination in the aquatic environment. Tech. Report No. 217, Fisheries Research Board of Canada, Biological Station, St. Andrews, N.B.

Zafiriou, D. C. 1972. Response of *Asterias vulgaris* to chemical stimuli. Mar. Biol. 17:100-107.

ZoBell, C. E. 1971. Sources and biodegradation of carcinogenic hydrocarbons, pp. 441-451. In Proceedings, Joint Conference on Prevention and Control of Oil Spills. American Petroleum Institute, Washington, D.C.

___________. 1973. Microbial degradation of oil: Present status, problems, and prerspectives, pp. 3-16, 153-162. In Ahearn and Meyers, eds., op. cit.

APPENDIX 10

MATRIX TABLES

Explanation of the Proximity Evaluation Matrix Tables

1. Distance From Shore — This is the distance in statute miles from the most shoreward point in the individual tract to the nearest point onshore.

2. Approximate Depth — This is the average depth in meters for each individual tract.

3. Proximity Values — These are values derived from the proximity evaluation for each individual tract in relation to various significant resources. The upper number is the proximity value for oil spills while the lower number is the proximity value for structures. For interpretations of these proximity values, the reader is referred to Sections III.E,F and G.

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 411	52.5	45	.1/0	.1/0	.1/0	.5/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 412	55	50	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 453	47.5	40	.1/0	.1/0	.1/0	.5/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 454	50	40	.1/0	.1/0	.1/0	.5/0	.1/0	.9/.9	.3/0	.1/0	.9/9	.1/0
NJ 18-3 455	53	45	.1/0	.1/0	.1/0	.5/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 456	56	55	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 457	59	55	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 458	62	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.5/0	.1/0	.9/.9	.1/0
NJ 18-3 497	49	40	.1/0	.1/0	.1/0	.5/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 498	51.5	45	.1/0	.1/0	.1/0	.5/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 499	54	50	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 500	57	55	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 501	60	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 502	62	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 540	47	50	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 541	50	50	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.3/0	.1/0	.9/19	.1/0
NJ 18-3 542	52.5	55	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 543	55	55	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 544	58	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 545	61	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 546	63.5	65	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 547	66.5	65	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 553	83.5	115	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.9/.9	.1/0	.9/.9	.1/0
NJ 18-3 544	87	125	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.9/.9	.1/0	.9/.9	.1/0
NJ 18-3 584	48	55	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 585	51	55	.1/0	.1/0	.1/0	.4/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 586	53.5	55	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES							MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand and Gravel Deposits	Aesthetics	Archeaology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 587	56.5	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/9	.3/0	.1/0	.9/9	.1/0
NJ 18-3 588	59.5	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/9	.3/0	.1/0	.9/9	.1/0
NJ 18-3 589	62.5	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/9	.3/0	.1/0	.9/9	.1/0
NJ 18-3 590	65.0	65	.1/0	.1/0	.1/0	.3/0	.1/0	.9/9	.3/0	.1/0	.9/9	.1/0
NJ 18-3 591	68.0	70	.1/0	.1/0	.1/0	.3/0	.1/0	.9/9	.4/0	.1/0	.9/9	.1/0
NJ 18-3 596	82.0	115	.1/0	.1/0	.1/0	.3/0	.1/0	.9/9	.6/9	.1/0	.9/9	.1/0
NJ 18-3 597	85.0	125	.1/0	.1/0	.1/0	.3/0	.1/0	.9/9	.8/9	.1/0	.9/9	.1/0
NJ 18-3 598	88.0	130	.1/0	.1/0	.1/0	.3/0	.1/0	.9/9	.9/9	.1/0	.9/9	.1/0
NJ 18-3 599	91.0	135	.1/0	.1/0	.1/0	.4/0	.1/0	.7/0	.9/9	.1/0	.9/9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 628	49.5	50	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 629	52	55	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 630	54.5	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 631	57.5	65	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 632	60.5	65	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 633	63	65	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 634	66	70	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 635	68.5	70	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 639	80	115	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.5/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 640	82.5	125	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.5/0	.1/0	.9/.9	.1/0
NJ 18-3 641	85.5	135	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.6/.9	.1/0	.9/.9	.1/0
NJ 18-3 642	88	135	.1/0	.1/0	.1/0	.3/0	.1/0	.8/.0	.8/.9	.1/0	.9/.9	.1/0
NJ 18-3 643	91	140	.1/0	.1/0	.1/0	.3/0	.1/0	.6/.0	.9/.9	.1/0	.9/.9	.1/0
NJ 18-3 673	53.3	55	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 674	56	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 675	59	65	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 676	61.5	65	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 677	64	70	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 678	66.5	70	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 682	78	100	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 683	80.5	120	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.5/0	.1/0	.9/.9	.1/0
NJ 18-3 684	83.5	130	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.5/0	.1/0	.9/.9	.1/0
NJ 18-3 685	86	140	.1/0	.1/0	.1/0	.3/0	.1/0	.8/.0	.5/0	.1/0	.9/.9	.1/0
NJ 18-3 686	89	140	.1/0	.1/0	.1/0	.3/0	.1/0	.6/.0	.6/.9	.1/0	.9/.9	.1/0
NJ 18-3 687	92	155	.1/0	.1/0	.1/0	.3/0	.1/0	.5/.0	.7/.9	.1/0	.9/.9	.1/0
NJ 18-3 718	58	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/.0	.9/.9	.1/0
NJ 18-3 719	60	65	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/.0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 720	62.5	70	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 721	65.5	75	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 722	68	75	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 723	70.5	75	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 724	73.5	85	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 725	76.5	90	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 726	79	105	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 727	82	125	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 728	85	135	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 729	87.5	145	.1/0	.1/0	.1/0	.3/0	.1/0	.7/.0	.5/0	.1/0	.9/.9	.1/0
NJ 18-3 730	90.5	155	.1/0	.1/0	.1/0	.3/0	.1/0	.6/.0	.5/0	.1/0	.9/.9	.1/0
NJ 18-3 765	67	75	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 766	69	75	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 767	72	85	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 768	75	85	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 769	77.5	95	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 770	80.5	115	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 771	83	130	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.4/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 772	86	140	.1/0	.1/0	.1/0	.3/0	.1/0	.8/.0	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 773	89	165	.1/0	.1/0	.1/0	.3/0	.1/0	.6/.0	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 809	68	75	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 810	71	75	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 811	73.5	85	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 812	76	90	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 813	79	95	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 816	87	185	.1/0	.1/0	.1/0	.3/0	.1/0	.7/.0	.4/0	.1/0	.9/.9	.1/0
NJ 18-3 854	72.5	80	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 855	75	85	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 856	77.5	90	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 857	80.5	110	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 858	83	150	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 898	74	85	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 899	76.5	80	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 900	79.5	95	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 901	81.5	125	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 902	84.5	185	.1/0	.1/0	.1/0	.2/0	.1/0	.8/.0	.3/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-3 942	75	80	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-3 943	78	90	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 944	81	110	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 945	83.5	175	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0
NJ 18-3 985	74	80	.1/0	.1.0	.1/0	.2/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-3 986	77	85	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-3 987	79.5	95	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-3 988	82	140	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.3/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-6 16	73	80	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-6 17	75.5	80	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-6 18	78	90	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-6 19	80.5	140	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-6 61	77	85	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-6 62	79.5	95	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-6 98	61	65	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 99	63	70	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 100	63.5	75	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-6 104	76	85	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-6 105	78.5	95	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-6 106	81	125	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0
NJ 18-6 139	55.5	60	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 140	58	55	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 141	60.5	65	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 142	63	70	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 143	65	70	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 144	67	75	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-6 183	58	55	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 184	60	65	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 185	62	70	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 186	64.5	70	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 187	66.5	75	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 188	69	75	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 189	71.5	80	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 190	74	85	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 191	76	100	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-6 192	79	130	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 226	57.5	55	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 227	59.5	60	.1/0	.1/0	.1/0	.3/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 228	62	65	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 229	64	70	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 230	66.5	75	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 231	68.5	75	.1/0	.1/0	.1/0	.2/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 232	71	80	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 233	73.5	85	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-6 234	76	100	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1 /0
NJ 18-6 235	78	125	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1 /0
NJ 18-6 270	60	60	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 271	62	60	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1 /0
NJ 18-6 272	64	65	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1 /0
NJ 18-6 273	66	70	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 274	68.5	75	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 275	71	75	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 276	73	80	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.2/0	.1/0	.9/.9	.1/0

BLOCK DATA			NATURAL and CULTURAL RESOURCES						MULTIPLE-USE ACTIVITIES			
Protraction Diagram and Block Number	Distance From Shore (Mi)	Approximate Depth (m)	Refuges/Wldlf. Mgmt. Areas	Marsh Communities	Sandy Beach Intertidal Communities	Sand And Gravel Deposits	Aesthetics	Archaeology	Shipping	Outdoor Recreation	Commercial Fishing	Sport Fishing
NJ 18-6 277	75.5	90	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0
NJ 18-6 278	78	125	.1/0	.1/0	.1/0	.1/0	.1/0	.9/.9	.1/0	.1/0	.9/.9	.1/0

APPENDIX 11

PROPOSED MID-ATLANTIC OCS OPERATING ORDERS

On December 8, 1975, a draft set of Proposed Operating Orders for the Mid-Atlantic OCS was published in the Federal Register the Orders issued included 1,2,3,4,5,7, and 12. Comments have been received on those Orders and changes made when applicable. The following pages contain the latest draft of the Orders (on the right side of the page) and the original version published in the Federal Register (on the left side of the page); the original version is only shown for those sections in which changes have been made in the revised draft - the nature of those changes is indicated on the left half of the page.

These Orders will be finalized prior to a sale in the Mid-Atlantic, if it were to be held. Orders 6,8,9,11,13,14, and 15 will be available for Federal and State review prior to the filing of operator's development plans. A proposal to issue OCS Order #14 was printed in the Federal Register on December 19, 1975; this has been included in this Appendix. A discussion of all OCS Orders is included in Section IV.A.

FEDERAL REGISTER NOTICE
DECEMBER 8, 1975

MID-ATLANTIC OCS ORDER NO. 1

Effective ------------

MARKING OF WELLS, PLATFORMS, AND STRUCTURES

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.37.

The operator shall comply with the following requirements. All departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

1. *Identification of Fixed Platforms or Structures.* Platforms and structures shall be identified at two diagonal corners by a sign with letters and figures not less than 30.5 centimetres (12 inches) in height with the following information: The name of lease operator, the block number in which the platform or structure is located, the area name shown on OCS Official Protraction Diagrams (or, where no name has been assigned, the Protraction Diagram number), and the platform or structure designation. The information shall be abbreviated as in the following example:

"The Blank Oil Company operates "C" platform on Block 999 of the Salisbury Area"

word changes

REVISED DRAFT , 1976

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
EASTERN AREA

MID-ATLANTIC OCS ORDER NO. 1

Effective ______________

"IDENTIFICATION OF WELLS, PLATFORMS, STRUCTURES, AND SUBSEA OBJECTS"

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.37.

The operator shall comply with the following requirements. All departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

1. Identification of Fixed Platforms or Structures. Platforms and structures shall be identified at two diagonal corners by a sign with letters and figures not less than 30 centimetres (12 inches) in height with the following information: The name of lease operator, the area name shown on OCS Official Protraction Diagrams (or, where no name has been assigned, the Protraction Diagram number), the block number in which the platform or structure is located, and the platform or structure designation. The information shall be abbreviated as in the following example:

   "The Blank Oil Company operates "C" platform on Block 999 of the Salisbury Area"

FEDERAL REGISTER NOTICE
DECEMBER 8, 1975

The identifying sign on the platform would show: "BOC-999-Sal.-C."

Word Change

2. *Identification of Nonfixed Platforms or Structures.* Floating semi-submersible platforms, bottom-setting mobile and floating drilling ships shall be identified by one sign with letters and figures not less than 30.5 centimetres (12 inches) in height affixed to the derrick so as to be visible from off the vessel and containing the following information: The name of the lease operator, the block number, the area designation based on OCS Official Leasing Maps, the OCS lease number, and the well number.

Word Change

Word Change

3. *Identification of Wells.* The OCS lease and well number shall be painted on, or a sign affixed to, each singly completed well. In multiple completed wells each completion shall be individually identified at the well head. All identifying signs shall be maintained in a legible condition.

REVISED DRAFT, 1976

The identifying sign on the platform would indicate:

"BOC-SAL-999-C."

2. Identification of Nonfixed Platforms or Structures. Floating semi-submersible platforms, bottom-setting mobile rigs, and drilling ships shall be identified by one sign with letters and figures not less than 30 centimetres (12 inches) in height affixed to the derrick so as to be visible from off the vessel and containing the following information: The name of the lease operator, the area designation based on OCS Official Leasing Maps, the block number, the OCS lease number, and the well number.

3. Identification of Wells. The OCS lease and well number shall be painted on, or a sign affixed to, each singly completed well. In multiple completed wells each completion shall be individually identified at the well head. All identifying signs shall be maintained in a legible condition.

FEDERAL REGISTER NOTICE
DECEMBER 8, 1976

4. *Identification of Subsea Objects.* Any subsea object presenting a hazard to navigation resulting from lease operations shall be identified in accordance with appropriate U.S. Coast Guard regulations.

revision

HARRY A. DUPONT,
Area Oil and Gas Supervisor.

Approved:

RUSSELL G. WAYLAND,
Chief, Conservation Division.

REVISED DRAFT, 1976

4. Identification of Subsea Objects. All subsea objects resulting from lease operations, and presenting a hazard to navigation or to deployment of commercial fishing devices, shall be identified with navigational markings. Such identification shall be in accordance with a design approved by the Supervisor and shall not be inconsistent with applicable U.S. Coast Guard regulations. These navigational markings shall be maintained on-site and operable at all times so long as the obstruction remains.

Harry A. DuPont
Area Oil and Gas Supervisor

Approved:

Russell G. Wayland
Chief, Conservation Division

REVISED DRAFT, 1976

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
EASTERN AREA

MID-ATLANTIC OCS ORDER NO. 2

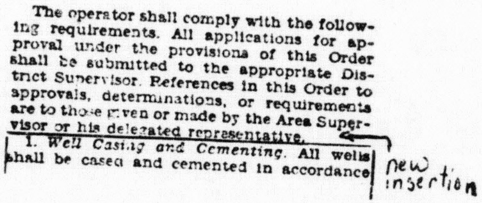
Effective ________________

DRILLING PROCEDURES

This Order is established pursuant to the authority prescribed in 30 CFR 250.11. All exploratory and development wells drilled for oil and gas shall be drilled in accordance with 30 CFR 250.34, 250.41, 250.91, and the provisions of this Order which shall continue in effect until field drilling rules are issued. When sufficient geologic and engineering information is obtained through exploratory drilling, operators may make application or the Area Supervisor may require an application for the establishment of field drilling rules. After field drilling rules have been established by the Area Supervisor, development wells shall be drilled in accordance with such rules.

All wells drilled under the provisions of this Order shall have been included in an exploratory or development plan for the lease as required under 30 CFR 250.34. Each Application for Permit to Drill (Form 9-331C) shall include all information required under 30 CFR 250.91, and shall include a notation of any proposed departures from

FEDERAL REGISTER NOTICE
DECEMBER 8, 1975



The operator shall comply with the following requirements. All applications for approval under the provisions of this Order shall be submitted to the appropriate District Supervisor. References in this Order to approvals, determinations, or requirements are to those given or made by the Area Supervisor or his delegated representative.

1. *Well Casing and Cementing*. All wells shall be cased and cemented in accordance

new insertion

REVISED DRAFT, 1976

the requirements of this Order. All departures from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 250.12(b).

The operator shall comply with the following requirements. All applications for approval under the provisions of this Order shall be submitted to the appropriate District Supervisor. References in this Order to approvals, determinations, or requirements are to those given or made by the Area Supervisor or his delegated representative.

1. Drilling Platforms and Vessels

   A. All drilling platforms and drilling vessels shall be capable of withstanding the oceanographic and meteorological conditions for the proposed area of operations. The operator must furnish evidence of the fitness of the drilling platform or vessel to perform the planned drilling operation at the proposed drilling location. Applications for drilling from mobile drilling platforms and drilling vessels shall include the following:

      (1) Design, drawings, equipment specifications, and performance data.

      (2) Operational criteria and a critical operations plan as described in Section 8 of this Order.

FEDERAL REGISTER NOTICE
DECEMBER 8, 1975

The operator shall comply with the following requirements. All applications for approval under the provisions of this Order shall be submitted to the appropriate District Supervisor. References in this Order to approvals, determinations, or requirements are to those given or made by the Area Supervisor or his delegated representative. → new insertion

1. *Well Casing and Cementing.* All wells shall be cased and cemented in accordance with the requirements of 30 CFR 250.41(a)(1), and the Application for Permit to Drill shall include the casing design safety factors for collapse, tension, and burst. In cases where cement has filled the annular space back to the ocean floor, the cement may be washed out or displaced to a depth not exceeding 12.2 metres (40 feet) below the ocean floor to facilitate casing removal upon well abandonment. For the purpose of this Order,

---

REVISED DRAFT, 1976

(3) Environmental conditions expected.

(4) Current classification or certification of fitness with operational limitations.

B. Prior to commencing operations, all drilling platforms and drilling vessels shall be given a complete inspection by a representative of the U.S. Geological Survey to insure compliance with OCS Orders and regulations.

C. Operators shall collect and report oceanographic, meteorological, and performance data during the period of operations. The type of information and the method of collecting shall be set forth in the proposed plan of operations.

2. Well Casing and Cementing. All wells shall be cased and cemented in accordance with the requirements of 30 CFR 250.41 (a)(1), and the Application for Permit to Drill shall include the casing design safety factors for collapse, tension, and burst. In cases where cement has filled the annular space back to the ocean floor, the cement may be washed out or displaced to a depth not exceeding 12 metres (40 feet) below the ocean floor to facilitate casing removal upon well abandonment. For the purpose of this Order, the several

casing strings in order of normal installation are drive or structural, conductor, surface, intermediate, and production casing.

For the surface, intermediate, and production casing strings, if there are indications of improper cementing such as lost returns, cement channeling, or mechanical failure of equipment, the operator shall recement or make the necessary repairs and run a temperature or cement bond log to verify that the casing has been adequately cemented.

The design criteria for all wells shall consider all pertinent factors for well control, including formation fracture gradients and pressures and casing setting depths. All casing, except drive pipe, shall conform to the specifications contained in "API Spec 5A - Casing, Tubing, and Drill Pipe," and shall be new pipe or reconditioned used pipe that has been tested to insure that it will meet API specifications for new pipe.

A. Drive or Structural Casing. This casing shall be set by drilling, driving, or jetting to a minimum depth of 30 metres (100 feet) below the ocean floor or to such greater depth required to support unconsolidated deposits and to provide hole stability for initial drilling

FEDERAL REGISTER NOTICE
DECEMBER 8, 1975

tial drilling operations. If this portion of the hole is drilled, the drilling fluid shall be of a type that is in compliance with the liquid disposal requirements of OCS Order No. 7, and a quantity of cement sufficient to fill the annular space back to the ocean floor shall be used.

B. *Conductor and Surface Casing.* Casing design and setting depths shall be based upon all engineering and geologic factors, including the presence or absence of hydrocarbons or other potential hazards and water depths.

(1) *Conductor Casing.* This casing shall be set at a depth in accordance with paragraph 1B(3) below. A quantity of cement sufficient to fill the annular space back to the ocean floor shall be used.

(2) *Surface Casing.* This casing shall be set at a depth in accordance with paragraph 1B(3) below and cemented in a manner necessary to protect all freshwater sands and provide well control until the next string of casing is set.

This casing shall be cemented with a quantity sufficient to fill the calculated annular space to at least 457.2 metres (1,500 feet) above the surface casing shoe and at least 61 metres (200 feet) inside the con-

numbering changes

REVISED DRAFT, 1976

operations. If this portion of the hole is drilled, the drilling fluid shall be of a type that is in compliance with the liquid disposal requirements of OCS Order No. 7, and a quantity of cement sufficient to fill the annular space back to the ocean floor shall be used.

B. Conductor and Surface Casing. Casing design and setting depths shall be based upon all engineering and geologic factors, including the presence or absence of hydrocarbons or other potential hazards and water depths.

(1) Conductor Casing. This casing shall be set at a depth in accordance with paragraph 2B(3) below. A quantity of cement sufficient to fill the annular space back to the ocean floor shall be used.

(2) Surface Casing. This casing shall be set at a depth in accordance with paragraph 2B(3) below and cemented in a manner necessary to protect all freshwater sands and provide well control until the next string of casing is set.

This casing shall be cemented with a quantity sufficient to fill the calculated annular space to at least 457 metres (1,500 feet) above the surface casing shoe and at least 61 metres (200 feet) inside the conductor casing or as approved by the District Supervisor. After drilling a maximum of 30 metres (100 feet) below the surface casing shoe, a pressure test shall be obtained to aid in determining a formation fracture gradient either by testing to formation leak-off or by testing to a predetermined equivalent mud weight. The results of this test and any subsequent tests of the formation shall be recorded on the driller's log and used to determine the depth and maximum mud weight to be used in drilling the intermediate hole.

(3) Conductor and Surface Casing Setting Depths. These strings of casing shall be set at the depth specified below, subject to approved variation to permit the casing to be set in a competent bed, or through formations determined desirable to be isolated from the well by pipe for safer drilling operations; provided, however, that the conductor casing shall be set immediately prior to drilling into formations known to contain oil or gas, or, if unknown, upon encountering such formations. These casing strings shall be run and cemented prior to drilling below the specified setting depths. For those wells which

may encounter abnormal pressure or conditions and for the initial wells in an area, the District Supervisor may prescribe an additional casing string and the exact setting depths. Except as otherwise may be prescribed, conductor casing setting depths shall be between 91 metres (300 feet) and 305 metres (1,000 feet) (TVD below ocean floor), and surface casing setting depths shall be between 305 metres (1,000 feet) and 1,372 metres (4,500 feet) (TVD below ocean floor).

Engineering, geophysical, and geologic data used to substantiate the proposed setting depths of the conductor and surface casings (such as estimated fracture gradients, pore pressures, shallow hazards, etc.) shall be furnished with the Application for Permit to Drill.

C. Intermediate Casing. One or more strings of intermediate casing shall be set when required by anticipated abnormal pressure, mud weight, sediment, and other well conditions. The proposed setting depth for intermediate casing will be based on the pressure tests of the exposed formation immediately below the surface casing shoe or on subsequent pressure tests.

A quantity of cement sufficient to cover and isolate all hydrocarbon zones and to isolate abnormal pressure intervals from normal pressure intervals shall be used. If a liner is used as an intermediate string, the cement shall be tested by a fluid entry or pressure test to determine whether a seal between the liner top and next larger string has been achieved. The test shall be recorded on the driller's log. When such liner is used as production casing, it shall be extended to the surface and cemented to avoid surface casing being used as production casing.

D. Production Casing. This string of casing shall be set before completing the well for production. It shall be cemented in a manner necessary to cover or isolate all zones which contain hydrocarbons, but in any case, a calculated volume sufficient to fill the annular space at least 152 metres (500 feet) above the uppermost producible hydrocarbon zone must be used. When a liner is used as production casing, the testing of the seal between the liner top and the next larger string shall be conducted as in the case of intermediate liners. The test shall be recorded on the driller's log.

E. Pressure Testing of Casing. Prior to drilling the plug after cementing, all casing strings, except the drive or structural casing, shall be pressure-tested as shown shall be pressure-tested as shown in the table below. The test pressure shall not exceed the internal yield pressure of the casing. The surface casing shall be tested with water in the top 100 feet of the casing. If the pressure declines more than 10 percent in 30 minutes, or if there is other indication of a leak, corrective measures shall be taken until a satisfactory test is obtained.

Casing	*Minimum surface pressure*
Conductor	14.1 Kg/cm² (200 psi).
Surface	70.3 Kg/cm² (1000 psi).
Intermediate, Liner, and production.	105.45 Kg/cm² (1500 psi) or 0.046 Kg/cm²/m (0.2 psi/ft.), whichever is greater.

number changes

After cementing any of the above strings, drilling shall not be commenced until a time lapse of eight hours under pressure for conductor casing string or 12 hours under pressure for all other strings. Cement is considered under pressure if one or more float valves are employed and shown to be holding the cement in place or when other means of holding pressure is used. All casing pressure tests shall be recorded on the driller's log.

F. *Directional Surveys.* Wells are considered vertical if inclination does not exceed an average of three degrees from the vertical.

---

in the table below. The test pressure shall not exceed the internal yield pressure of the casing. The surface casing shall be tested with water in the top 30 metres (100 feet) of the casing. If the pressure declines more than 10 percent in 30 minutes, or if there is other indication of a leak, corrective measures shall be taken until a satisfactory test is obtained.

Casing	Minimum Surface Pressure
Conductor	1379 kilopascals (kPa) (200 psi)
Surface	6894 kPa (1000 psi)
Intermediate, Liner, and Production	10,341 kPa (1500 psi) or 4.52 kPa/m (0.2 psi/ft.), whichever is greater

After cementing any of the above strings, drilling shall not be commenced until a time lapse of eight hours under pressure for conductor casing string or 12 hours under pressure for all other strings. Cement is considered under pressure if one or more float valves are employed and shown to be holding the cement in place or when other means of holding pressure is used. All casing pressure tests shall be recorded on the driller's log.

3. Directional Surveys. Wells are considered vertical if inclination does not exceed an average of three degrees

from the vertical. Inclination surveys shall be obtained on all vertical wells at intervals not exceeding 152 metres (500 feet) during the normal course of drilling.

Wells are considered directional if inclination exceeds an average of three degrees from the vertical. Directional surveys giving both inclination and azimuth shall be obtained on all directional wells at intervals not exceeding 152 metres (500 feet) during the normal course of drilling and at intervals not exceeding 30 metres (100 feet) in all angle change portions of the hole.

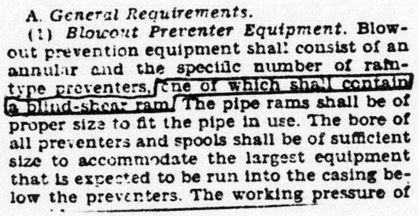
On both vertical and directional wells, directional surveys giving both inclination and azimuth shall be obtained at intervals not exceeding 152 metres (500 feet) prior to, or upon, setting surface or intermediate casing, liners, and at total depth.

Composite directional surveys shall be filed with the District Supervisor. The interval shown will be from the bottom of conductor casing, or, in the absence of conductor casing, from the bottom of drive or structural casing to total depth. In calculating all surveys, a correction from true north to Universal Transverse Mercator-Grid north shall be made after making the magnetic to true north correction.

Blowout Prevention Equipment. Blowout preventers and related well-control equipment shall be installed, used, and tested in a manner necessary to prevent blowouts. Prior to drilling below the drive pipe or structural casing and until drilling operations are completed, blowout prevention equipment shall be installed and maintained ready for use as follows:

A. **General Requirements**.

(1) **Blowout Preventer Equipment**. Blowout prevention equipment shall consist of an annular and a specific number of ram-type preventers. (Subsea blowout-preventer stacks used with floating drilling vessels shall be equipped with one set of blind-shear rams). The pipe rams shall be of proper size to fit the pipe in use. The bore of all preventers and spools shall be of sufficient size to accommodate the largest equipment that is expected to be run into the casing below the preventers. The working


A. *General Requirements.*

(1) *Blowout Preventer Equipment.* Blowout prevention equipment shall consist of an annular and the specific number of ram-type preventers, one of which shall contain a blind-shear ram. The pipe rams shall be of proper size to fit the pipe in use. The bore of all preventers and spools shall be of sufficient size to accommodate the largest equipment that is expected to be run into the casing below the preventers. The working pressure of

— deleted with new insertion

any blowout preventer shall exceed the maximum anticipated surface pressure to which it may be subjected. — insertion

All preventers shall be equipped with:

(a) A hydraulic actuating system that provides sufficient accumulator capacity to close all blowout prevention equipment units with a 60 percent operating fluid reserve at 84.4

word change — Kg/cm^2 (1200 psi). A high pressure nitrogen or accumulator back-up system shall be provided with sufficient capacity to close all

pressure of any blowout preventer shall exceed the maximum anticipated surface pressure to which it may be subjected. Information submitted with the Application for Permit to Drill shall include the maximum anticipated surface pressure and the criteria used to determine this pressure. A fail safe design shall be incorporated into the blowout-prevention system and shall include dual control systems and fail safe valving on critical lines and outlets. In addition, for subsea blowout-preventer stacks, a subsea accumulator system is required to provide fast closure of preventers and for cycling all critical functions in case of loss of connection to the surface.

All preventers shall be equipped with:

(a) A hydraulic actuating system that provides sufficient accumulator capacity to close all blowout prevention equipment units with a 50 percent operating fluid reserve at 8273 KPa (1200 psi). A high pressure nitrogen or other accumulator back-up system shall be provided with sufficient capacity to close all blowout preventers and hold them closed. Locking devices shall be provided on the ram-type preventers.

(b) An operable remote blowout-preventer-control station shall be provided, in addition to the one on the drilling floor.

(c) A drilling spool with side outlets, if side outlets are not provided in the blowout preventer body, shall be installed to provide for a kill line and choke manifold. An auxiliary connection for an emergency kill or choke line shall be provided below any preventur that is in use and not located on the sea floor.

(d) A kill line with a master valve located next to the well. This valve shall not be used for normal opening or closing on flowing fluids. The kill line shall have at least one control valve in addition to the master valve.

(e) A choke manifold equipped with a hydraulic control valve, a master valve, three adjustable chokes of which one shall be a hydraulic

(e) A choke manifold equipped with a hydraulic control valve, a master valve, three adjustable chokes of which one shall be a hydraulic adjustable choke, and an accurate pressure gauge. The choke manifold outlets shall be connected in such a manner that the well fluids may be directed to production facilities or emergency storage.

– word change

(f) A fill-up line.

(g) The annular type preventer shall be equipped for automatic actuation in case of failure of the control system.

– word change

(h) All valves, pipe, and fittings that can be exposed to pressure from the wellbore shall be of a pressure rating at least equal to that of the blowout-prevention equipment.

insertion

adjustable choke, and an accurate pressure gauge. The choke manifold outlets shall be connected in a manner such that the returns may be directed to the mud system or other appropriate storage.

(f) A fill-up line.

(g) The annular type preventer shall be equipped with an alternate control to be used in case the primary controls fail.

(h) All valves, pipes, and fittings upstream of and including the choke manifold that can be exposed to pressure from the wellbore shall be of a pressure rating at least equal to that required of the blowout-prevention equipment.

(2) Auxiliary Equipment. The following auxiliary equipment shall also be provided:

(a) A top kelly cock shall be installed below the swivel, and an essentially full-opening kelly cock of such design that it can be run through blowout preventers shall be installed at the bottom of the kelly.

(b) An inside blowout preventer and a full opening drill string safety valve in the open position shall be maintained on the rig floor at all times while drilling operations are being conducted. Valves shall be maintained on the rig floor to fit all pipe that is in the drill string. A safety valve shall be available on the rig floor assembled with the proper connection to fit the casing string that is being run in the hole.

(c) A socket-type full-opening safety valve that is capable of being dropped over any drill pipe tool joint in use shall be maintained on the rig floor ready for use. — deleted

B. *Drive Pipe or Structural Casing.* Before drilling below this string, at least one remotely controlled, annular-type blowout preventor or pressure-rotating, pack-off-type head and equipment for circulating the drilling fluid to the drilling structure or vessel shall be installed.

When the blowout preventer system is on the ocean floor, the choke and kill lines or equivalent vent lines, equipped with necessary connections and fittings, shall be used for diversion. An annular preventer or pressure-rotating, pack-off-type head, equipped with suitable diversion lines as described above and installed on top of the marine

(b) An inside blowout preventer and an essentially full opening drill string safety valve in the open position shall be maintained on the rig floor at all times while drilling operations are being conducted. Valves shall be maintained on the rig floor to fit all pipe that is in the drill string. A safety valve shall be available on the rig floor assembled with the proper connection to fit the casing string that is being run in the hole.

B. Drive Pipe or Structural Casing. Before drilling below this string, at least one remotely controlled, annular-type blowout preventer or pressure-rotating, pack-off-type head and equipment for circulating the drilling fluid to the drilling structure or vessel shall be installed.

When the blowout-preventer system is on the ocean floor, the choke and kill lines or equivalent vent lines, equipped with necessary connections and fittings, shall be used for diversion. An annular preventer or pressure-rotating, pack-off-type head, equipped with suitable diversion lines as described above and installed on top of the marine riser, to permit the diversion of hydrocarbons and other fluids, may be utilized for diversion. The diverter system providing at least the equivalent of two 15 centimetre (6-inch) lines (or equivalent in internal cross-sectional area) and full-open or butterfly valves shall be installed in order to permit the full diversion of hydrocarbons and other fluids. The diverter system shall be equipped with automatic, remote-controlled valves which open prior to shutting in the well, with at least two lines venting in different directions to accomplish downwind diversion. A schematic diagram and operational procedure for the diverter system shall be submitted with the Application for Permit to Drill (Form 9-331C) to the District Supervisor for approval.

In drilling operations where a floating or semi-submersible type of drilling vessel is used and formation competency at the structural casing setting depth is not adequate to permit circulation of drilling fluids to the vessel while drilling conductor hole, a program which provides for safety in these operations shall be described and submitted to the District Supervisor for approval. This program shall include all known pertinent and relevant information, including seismic and geologic data, water depth, drilling-fluid hydrostatic pressure, schematic diagram from rotary table to proposed conductor casing seat, and contingency plan for moving off location. In all areas where shallow hazards or hydrocarbons are unknown, seismic data shall be obtained, and a small-diameter initial pilot hole from the bottom of drive or structural casing to proposed conductor casing seat shall be drilled to aid in determining the presence or absence of these hazards.

C. Conductor Casing. Before drilling below this string, at least one remotely controlled, annular-type blowout preventer and equipment for circulating the drilling fluid to the drilling structure or vessel shall be installed. A diverter system as described in paragraph 2B above shall be installed.

D. Surface Casing. Before drilling below this string, the blowout prevention equipment shall include a minimum of: (i) three remote-controlled, hydraulically operated blowout preventers, including one equipped word deleted

equipped with pipe rams, one with blind shear rams, and one annular type; (2) a drilling spool with side outlets, if side outlets are not provided in the blowout preventer body; (3) a choke line and manifold; (4) a kill line separate from choke line; and (5) a fill-up line.

insertion

E. *Intermediate Casing*. Before drilling below this string, the blowout prevention equipment shall include a minimum of: (1) four remote-controlled, hydraulically operated blowout preventers with a working pressure which exceeds the maximum anticipated surface pressure, including at least two equipped with pipe rams, one with blind shear rams, and one annular type; (2) a drilling spool with side outlets, if side outlets are not provided in the blowout preventer body; (3) a choke line and manifold; (4) a kill line separate from choke line; and (5) a fill-up line.

word deleted

insertion

with pipe rams, one with blind rams, and one annular type. (Subsea blowout-preventer stacks used with floating drilling vessels shall be equipped with one set of blind-shear rams); (2) a drilling spool with side outlets, if side outlets are not provided in the blowout preventer body; (3) a choke line and manifold; (4) a kill line separate from choke line; and (5) a fill-up line.

E. Intermediate Casing. Before drilling below this string, the blowout prevention equipment shall include a minimum of: (1) four remote-controlled, hydraulically operated blowout preventers with a working pressure which exceeds the maximum anticipated surface pressure, including at least two equipped with pipe rams, one with blind rams, and one annular type. (Subsea blowout-preventer stacks used with floating drilling vessels shall be equipped with one set of blind-shear rams); (2) a drilling spool with side outlets, if side outlets are not provided in the blowout preventer body; (3) a choke line and manifold; (4) a kill line separate from choke line; and (5) a fillup line.

F. *Testing.*

(1) *Pressure Test.* Ram-type blowout preventers and related control equipment shall be tested to the rated working pressure of the stack assembly, or at the working pressure of the casing, whichever is the lesser. Annular-type preventers shall be tested to 70 percent of these pressure requirements. They shall be tested: (a) when installed, (b) before drilling out after each string of casing is set, (c) not less than once each week from each of the control stations, and (d) following repairs that require disconnecting a pressure seal in the assembly.

word change

(2) *Actuation.* While drill pipe is in use, the ram-type blowout preventers equipped with pipe rams shall be actuated while out of the hole, once each trip. If a tapered drill string is in use, the smaller size pipe rams shall be actuated on the appropriate size pipe, once each trip. Accumulators or accumulators and pumps shall maintain a pressure capacity reserve at all times to provide for repeated operation of hydraulic preventers. An operable remote blowout-

word change

F. Testing.

(1) Pressure Test. Ram-type blowout preventers and related control equipment shall be tested to the rated working pressure of the stack assembly, or at the working pressure of the casing, whichever is the lesser. Annular-type preventers shall be tested to 70 percent of these pressure requirements. They shall be tested: (a) when installed, (b) before drilling out after each string of casing is set, (c) not less than once each week while conducting drilling operations, and (d) following repairs that require disconnecting a pressure seal in the assembly.

(2) Actuation. While drill pipe is in use, the ram-type blowout preventers equipped with pipe rams shall be actuated at least once each day. If a tapered drill string is in use, the smaller size rams shall be actuated on the appropriate size pipe, once each trip. The blind rams shall be actuated while out of the hole once each trip. Accumulators or accumulators and pumps shall maintain a pressure capacity reserve at all times to provide for repeated operation of hydraulic preventers.

An operable remote blowout-preventer-control station shall be provided in addition to the one on the drilling floor. Each control station shall be checked for proper operations weekly, in conjunction with the pressure test.

(3) Drills. A blowout prevention drill shall be conducted weekly for each drilling crew to insure that all equipment is operational and that crews are properly trained to carry out emergency duties.

(4) Records. All blowout preventer tests and crew drills shall be recorded on the driller's log.

5. Mud Program. The characteristics, use, and testing of drilling mud and the conduct of related drilling procedures shall be such as are necessary to prevent the blowout of any well. Quantities of mud materials sufficient to insure well control shall be maintained readily accessible for use at all times.

A. Mud Control. Before starting out of the hole with drill pipe, the mud shall be properly conditioned. Proper conditioning requires either circulation with the drill pipe just off bottom to the extent that the annular volume is displaced, or proper documentation in the driller's log prior to pulling the drill pipe that: (1) there was no indication of influx of formation fluids prior to starting to pull the drill pipe from the hole, (2) the weight of the returning mud is not less than the weight of the mud entering the hole, and (3) other mud properties recorded on the daily drilling log are within the specified ranges at the stage of drilling the hole to perform their required functions. In those cases when the hole is circulated, the driller's log shall be so noted.

When coming out of the hole with drill pipe, the annulus shall be filled with mud before the mud level drops 30 metres (100 feet). A mechanical device for measuring the amount of mud required to fill the hole shall be utilized, and any time there is an indication of swabbing, or influx of formation fluids, the necessary safety devices and action shall be employed to control the well. The mud shall not be circulated and conditioned, except on or near bottom, unless well conditions prevent running the drill pipe back to bottom. The mud in the hole shall be circulated or reverse-circulated prior to pulling drill-stem test tools from the hole.

The hole shall be filled by accurately measured volumes of mud. The number of stands of drill pipe and drill collars that may be pulled between the times of filling the hole shall be calculated and posted. The number of barrels and pump strokes required to fill the hole for this designated number of stands of drill pipe and drill collars shall be posted. For each casing string, the maximum pressure which may be applied to the blowout preventer before controlling excess pressure by bleeding through the choke shall be posted near the driller. Drill pipe pressure shall be monitored during the bleeding procedure for well control.

An operable degasser shall be installed in the mud system prior to the commencement of drilling operations and shall be maintained for use throughout the drilling and completion of the well.

B. Mud Test Equipment. Mud test equipment shall be maintained on the drilling rig at all times, and mud tests shall be performed daily, or more frequently as conditions warrant. The following mud-system monitoring equipment shall be installed (with derrick floor indicators) and used at the point in the drilling operation when mud returns are established and throughout subsequent drilling operations:

(1) Recording mud pit level indicator to determine mud pit volume gains and losses. This indicator shall include a visual and audio warning device.

(2) Mud volume measuring device for accurately determining mud volumes required to fill the hole on trips.

(3) Mud return indicator to determine that returns essentially equal the pump discharge rate.

(4) Gas-detecting equipment to monitor the drilling mud returns.

C. Mud Quantities. The operator shall state in the Application for Permit to Drill the minimum quantities of mud material, including weighting material, to be maintained at the drill site for emergency use. This quantity shall not be less than the amount necessary to make a mud volume equal to twice the calculated capacity of the active down hole and surface mud system. The minimum quantity of

C. *Mud Quantities.* The operator shall state in the Application for Permit to Drill the minimum quantities of mud material, including weighting material, to be maintained at the drill site for emergency use. ← insertion Daily inventories of mud materials, including weighting material, shall be recorded and maintained at the drill site. Drilling operations shall be suspended in the absence of approved minimum quantities of mud materials for emergency use.

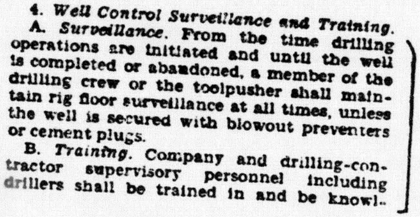
weighting material to be maintained at the drill site shall be sufficient to overcome the highest anticipated formation pressure with the mud weight at least one pound per gallon greater than the weight required to overcome such formation pressure. Daily inventories of mud materials, including weighting material, shall be recorded and maintained at the drill site. Drilling operations shall be suspended in the absence of approved minimum quantities of mud materials for emergency use.

6. Supervision, Surveillance, and Training.

A. **Supervision**. A representative of the operator shall provide, on site, supervision of drilling operations on a 24-hour basis.

B. **Surveillance**. From the time drilling operations are initiated and until the well is completed or abandoned, a member of the drilling crew or the toolpusher shall maintain rig floor surveillance continuously, unless the well is secured with blowout preventors or cement plugs.

C. **Training**. Company and drilling contractor supervisory personnel including drillers shall be trained in and



4. *Well Control Surveillance and Training.*

A. *Surveillance*. From the time drilling operations are initiated and until the well is completed or abandoned, a member of the drilling crew or the toolpusher shall maintain rig floor surveillance at all times, unless the well is secured with blowout preventers or cement plugs.

B. *Training*. Company and drilling-contractor supervisory personnel including drillers shall be trained in and be knowl-

revision

edgeable of present-day well control methods. The operator shall maintain a record of such training on the facility. Training shall include:

(1) Abnormal pressure detection methods.

(2) Well control methods and procedures.

) revised

5. *Hydrogen Sulfide*. When drilling operations are undertaken to penetrate reservoirs known or expected to contain hydrogen sulfide (H_2S), or, if unknown, upon encountering H_2S, the following preventive measures shall be taken to control the effects of the toxicity, flammability, and corrosive characteristics of H_2S. Alternative equipment or procedures that achieve the same or greater

revised to indicate printing of GSS-OCS-1

qualified for present-day well control. Records of such training and qualification shall be maintained at the drill site. Training shall include but is not limited to:

(1) Abnormal pressure detection methods.

(2) Well-control methods and procedures.

The operator shall additionally require well-control training for drillers in addition to the required weekly blowout prevention drills. Written verification of compliance with these provisions shall be filed with the Supervisor. As standards for training are developed for all members of the drilling crew, they will be incorporated into this Order. Compliance shall be considered a prerequisite to approval of any drilling operation.

Hydrogen Sulfide. When drilling operations are undertaken to penetrate reservoirs known or expected to contain hydrogen sulfide (H_2S), or, if unknown upon encountering H_2S, the preventive measures and operating practices set forth in U.S. Geological Survey Outer Continental Shelf Standard No. 1, (GSS-OCS-1), "Safety Requirements for Drilling Operations in a Hydrogen Sulfide Environment," February 1976, shall be followed.

This section is a new insertion

Critical Operations and Curtailment Plans. Certain operations performed in drilling are more critical than others with respect to well control, fire, explosion, oil spills, and other discharge or emissions. These operations may occur during drilling, running casing, logging, drill-stem testing, well completion, or wire-line operations.

Each operator shall file with the Supervisor for approval of a Critical Operations and Curtailment Plan for the lease, which shall contain:

A. A list or description of the critical drilling operations that are or are likely to be conducted on the lease. Such list or description shall specify the operations to be cased, limited, or not to be commenced under given circumstanes or conditions. The list shall include operations such as:

   (1) Drilling in close proximity to another producing well.

   (2) Drill-stem testing.

   (3) Running and cementing casing.

   (4) Cutting and recovering casing.

(5) Known or anticipated meteorological or oceanographical conditions.

(6) Availability of personnel and equipment for the particular operation to be conducted.

(7) Other factors peculiar to the particular lease under consideration.

This section is a new insertion

C. When any such circumstance or condition listed or described in the plan occurs or other operational limits are encountered, the operator shall notify the Supervisor and shall curtail the critical operations as set forth under A above. In the conduct of the critical operations, full consideration shall be given to pertinent factors such as supply of well control materials, subsurface conditions, inventory of spill-containment equipment, weather conditions, particular esthetic conditions, fire hazards, available transportation equipment, spill-control response time, and nature of work planned.

D. Any deviations in the plan shall require prior approval by the Supervisor except in case of an emergency in which event the supervisor shall be notified as soon as possible.

This section is a new insertion

E. The operator shall review the plan at least annually. Notification of the review and any amendments or modifications to the plan shall be filed with the Supervisor.

Harry A. DuPont
Area Oil and Gas Supervisor

Approved:

Russell G. Wayland
Chief, Conservation Division

750

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
EASTERN AREA

MID-ATLANTIC OCS ORDER NO. 3

Effective ________________

PLUGGING AND ABANDONMENT OF WELLS

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.15. The operator shall comply with the following minimum plugging and abandonment procedures which have general application to all wells drilled for oil and gas. Plugging and abandonment operations must not be commenced prior to obtaining approval from an authorized representative of the Geological Survey. Oral approvals shall be in accordance with 30 CFR 250.13. All departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

1. Permanent Abandonment.

A. Isolation in Uncased Hole. In uncased portions of wells, cement plugs shall be spaced to extend 30 metres (100 feet) below the bottom to 30 metres (100 feet) above the top of any oil, gas, and fresh water zones so as to isolate them in the strata in which they are found and to prevent them from escaping into other strata. Additional cement plugs may be required to protect other

1. ***Permanent Abandonment.***

A. ***Isolation in Uncased Hole.*** In uncased portions of wells, cement plugs shall be spaced to extend 30.5 metres (100 feet) below the bottom to 30.5 metres (100 feet) above the top of any oil, gas, and fresh water zones so as to isolate them in the strata in which they are found and to prevent them from escaping into other strata. Additional cement plugs may be required to protect other minerals, or to prevent migration of fluids in the well bore. No more than 762.0 metres (2,500 feet) of uncased hole shall be left without a cement plug of at least 30.5 metres (100 feet) in length in wells requiring a mud weight in excess of 1.44kg/1 (12.0 ppg) for control.

wording change

752

minerals, or to prevent migration of fluids in the well bore. No more than 762 metres (2,500 feet) of uncased hole shall be left without a cement plug of at least 30 metres (100 feet) in length in wells requiring a mud weight in excess of 1.44kg/dm^3 (12.0 ppg) for control.

B. Isolation of Open Hole. Where there is open hole (uncased and open into the casing string above) below the casing, a cement plug shall be placed in the deepest casing string by (1) or (2) below, or in the event lost circulation conditions exist or are anticipated, the plug may be placed in accordance with (3) below:

(1) A cement plug placed by displacement method so as to extend a minimum of 30 metres (100 feet) above and 30 metres (100 feet) below the casing shoe.

(2) A cement retainer with effective back pressure control set not less than 15 metres (50 feet), nor more than 30 metres (100 feet), above the casing shoe with a cement plug calculated to extend at least 30 metres (100 feet) below the casing shoe and 15 metres (50 feet) above the retainer.

(3) A permanent type bridge plug set within 46 metres (150 feet) above the casing shoe with 15 metres (50 feet) of cement on top of the bridge plug. This plug shall be tested prior to placing subsequent plugs.

C. Plugging or Isolating Perforated Intervals. A cement plug shall be placed opposite all open perforations (perforations not squeezed with cement) extending a minimum of 30 metres (100 feet) above and 30 metres (100 feet) below the perforated interval or down to a casing plug, whichever is less. In lieu of the cement plug, the following two methods are acceptable, provided the perforations are isolated from the hole below:

(1) A cement retainer with effective back pressure control set not less than 15 metres (50 feet) nor more than 30 metres (100 feet) above the top of perforated interval with a cement plug calculated to extend at least 30 metres (100 feet) below the bottom of the perforated interval and 15 metres (50 feet) above the retainer.

753

(2) A permanent type bridge plug set within 46 metres (150 feet) above the top of the perforated interval with 15 metres (50 feet) of cement on top of the bridge plug.

D. Plugging of Casing Stubs. If casing is cut and recovered, a cement plug 61 metres (200 feet) in length shall be placed to extend 30 metres (100 feet) above and 30 metres (100 feet) below the stub. A retainer may be used in setting the required plug.

E. Plugging of Annular Space. No annular space that extends to the ocean floor shall be left open to drilled hole below. If this condition exists, the annulus shall be plugged with cement.

F. Surface Plug Requirement. A cement plug of at least 46 metres (150 feet), with the top of the plug 46 metres (150 feet) or less below the ocean floor, shall be placed in the smallest string of casing which extends to the surface.

G. Testing of Plugs. The setting and location of the first plug below the top 46-metre (150-foot) plug, will be verified by either (1) placing a minimum pipe weight of 6,800 kilograms (15,000 pounds) on the plug, or where

754

a cement retainer or bridge plug, it is only necessary that the setting of the retainer or bridge plug be verified by placing at least 6,800.0 kilograms (15,000 pounds) on it prior to placing cement on top. — insertion

H. *Mud*. Each of the respective intervals of the hole between the various plugs shall be filled with mud fluid of sufficient density to exert hydrostatic pressure exceeding the greatest formation pressure encountered while drilling such interval.

this plug is placed utilizing a cement retainer or bridge plug, it is only necessary that the setting of the retainer or bridge plug be verified by placing at least 6,800 kilograms (15,000 pounds) on it prior to placing cement on top, or (2) testing with a minimum pump pressure of 6,894 kPA (1,000 psi) with no more than a 10 percent pressure drop during a 15-minute period.

H. Mud. Each of the respective intervals of the hole between the various plugs shall be filled with mud fluid of sufficient density to exert hydrostatic pressure exceeding the greatest formation pressure encountered while drilling such interval.

I. Clearance of Location. All casing and piling shall be severed and removed to that depth below the ocean floor approved by the Area Superviser after a review of data on the ocean bottom conditions. The operator shall verify that the location has been cleared of all obstructions.

2. Temporary Abandonment. Any drilling well which is to be temporarily abandoned shall be mudded and cemented as required for permanent abandonment except for requirements F and I

of section 1 above. When casing extends above the ocean floor, a mechanical bridge plug (retrievable or permanent) shall be set in the casing between 4.6 and 61.0 metres (15 and 200 feet) below the ocean floor.

Harry A. DuPont
Area Oil and Gas Supervisor

Approved:

Russell G. Wayland
Chief, Conservation Division

756

duction has been approved. All applica-
ns for suspension of production for an
itial period should be submitted prior to
he expiration of the term of a lease. The
Area Supervisor may approve a suspension of
production provided at least one well has
en drilled on the lease and determined to
e capable of being produced in paying
quantities. The temporary or permanent
abandonment of a well will not preclude
approval of a suspension of production as
provided in 30 CFR 250.12(d)(1). All de-
partures from the requirements specified
in this Order must be approved pursuant to

insertion

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
EASTERN AREA

MID-ATLANTIC OCS ORDER NO. 4

Effective ________________

SUSPENSIONS AND DETERMINATION OF WELL PRODUCIBILITY

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in acccordance with 30 CFR 250.12(d)(1). An OCS lease provides for extension beyond its primary term for as long as oil or gas may be produced from the lease in paying quantities. The term "paying quantities" as used herein means production in quantities sufficient to yield a return in excess of operating costs. An OCS lease may be maintained beyond the primary term, in the absence of actual production, when a suspension of production has been approved. All applications for suspension of production for an initial period should be submitted prior to the expiration of the term of a lease. The Area Supervisor may approve a suspension of production provided at least one well has been drilled on the lease and determined to be capable of producing in paying quantities, and the operator has met the requirements for diligent development as defined in OCS Order No. 14. The temporary or permanent abandonment of a well will not preclude approval of a suspension of production as provided in 30 CFR 250.12(d)(1). All departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

To provide data necessary to determine that a well may be capable of producing in paying quantities, the following are minimum requirements:

1. Oil Wells. A production test of at least two hours duration, following stabilization of flow.

2. Gas Wells. A deliverability test of at least two hours duration, following stabilization of flow, or a four-point back-pressure test.

3. Well Data. All pertinent engineering, geologic, and economic data shall be submitted to the District Supervisor and will be considered in determining whether or not a well is capable of being produced in paying quantities.

4. Witnessing and Results. All tests must be witnessed by an authorized representative of the Geological Survey. Test data accompanied by operator's affidavit, or third-party test data, may be accepted in lieu of a witnessed test provided prior approval is obtained from the District Supervisor.

Harry A. DuPont
Area Oil and Gas Supervisor

Russell G. Wayland
Chief, Conservation Division

1. *Installation*. All tubing installations open to hydrocarbon-bearing zones shall be equipped with a surface-controlled or other remotely controlled subsurface safety device, to be installed at a depth of 30.5 metres (100 feet) or more below the ocean floor unless, after application and justification, the well is determined to be incapable of flowing oil or gas. These installations shall be made

— wording change

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
EASTERN AREA

MID-ATLANTIC OCS ORDER NO. 5

Effective ________________

SUBSURFACE SAFETY DEVICES

This Order is established pursuant to the authority prescribed in 30 CRF 250.11 and in accordance with 30 CFR 250.41(b). The operator shall comply with the following requirements. All departures from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 250.12(b). All applications for approval under the provisions of this Order shall be submitted to the District Supervisor. Reference in this Order to approvals, determinations, or requirements are to those given or made by the Area Supervisor or his delegated representative.

1. **Installation**. All tubing installations open to hydrocarbon-bearing zones shall be equipped with a surface-controlled subsurface safety device. The surface controls may be located onsight or remotely. The device is to be installed at at a depth of 30 metres (100 feet) or more below the ocean floor unless, after application and justification, the well is determined to be incapable of flowing oil or gas. These installations shall be made within

760

two days after stabilized production is established. The well shall not be left unattended while open to production before a subsurface safety device is installed.

A. Shut-in Wells. A tubing plug shall be installed in lieu of, or in addition to, other subsurface safety devices if a well has been shut in for a period of six months. Such plugs shall be set at a depth of 30 metres (100 feet) or more below the ocean floor and shall be of the pump-through type. All wells perforated and completed, but not placed on production, shall be equipped with a subsurface safety device or tubing plug within two days after completion.

B. Injection Wells. Subsurface safety devices above shall be installed in all injection wells unless, after application and justification, it is determined that the well is incapable of flowing which condition shall be verified annually.

2. Design, Testing, and Inspection. Subsurface safety devices shall be designed, adjusted, installed, and maintained to insure reliable operation. During testing and inspection

A. Surface-Controlled Subsurface Safety Devices.

(1) *Quality Assurance and Performance.* The operator shall use subsurface safety devices that comply with the minimum standards set forth in "API Spec 14 A, October — insert 1973, Subsurface Safety Valves," for quality assurance including design, material, and functional test requirements, and for verification of independent party performance testing and manufacturer functional testing of such valves.

(2) *Installation and Testing.* The operator shall comply with the minimum recommended practices set forth in "API RP 14 B, October 1973, Design, Installation, and Operation of Subsurface Safety Valve Systems," — insert which contain procedures for design calculations, safe installation, and operating and testing. Each surface-controlled subsurface safety device installed in a well shall be tested in place for proper operation when in-

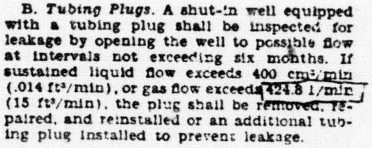
---

procedures, the well shall not be left unattended while open to production unless a properly operating subsurface safety device has been installed in the well.

A. Surface-Controlled Subsurface Safety Devices.

(1) Quality Assurance and Performance. The operator shall use subsurface safety devices that comply with the minimum standards set forth in "API Spec 14 A, First Edition, October 1973, Subsurface Safety Valves," or supplements thereto as approved by the Area Supervisor, for quality assurance including design, material, and functional test requirements, and for verification of independent party performance testing and manufacturer functional testing of such valves.

(2) Installation and Testing. The operator shall comply with the minimum recommended practices set forth in "API RP 14 B, First Edition, October 1973, Design, Installation, and Operation of Subsurface Safety Valve Systems," or supplements thereto as approved by the Area Supervisor, which contain procedures for design calculations, safe installation, and operating and testing. Each surface-controlled subsurface safety device installed in a well shall be tested in place



B. *Tubing Plugs*. A shut-in well equipped with a tubing plug shall be inspected for leakage by opening the well to possible flow at intervals not exceeding six months. If sustained liquid flow exceeds 400 cm³/min (.014 ft³/min), or gas flow exceeds 424.8 l/min (15 ft³/min), the plug shall be removed, repaired, and reinstalled or an additional tubing plug installed to prevent leakage.

- word change

for proper operation when installed, or reinstalled, at least monthly for the next six months and quarterly thereafter. If the device does not operate properly, it shall be promptly removed, repaired, and reinstalled or replaced and tested to insure proper operation.

B. Tubing Plugs. A shut-in well equipped with a tubing plug shall be inspected for leakage by opening the well to possible flow at intervals not exceeding six months. If sustained liquid flow exceeds 400 cm^3/min (.014 ft^3/min), or gas flow exceeds 425 dm^3/min (15 ft^3/min), the plug shall be promptly removed, repaired, and reinstalled or an additional tubing plug installed to prevent leakage.

3. Temporary Removal. Each wireline- or pumpdown-retrievable subsurface safety device may be removed, without further authorization or notice, for a routine operation which does not require approval of a Sundry Notice and Report on Wells (Form 9-331) for a period not to exceed fifteen days. The well shall be clearly identified as being without a subsurface safety device and shall not be left unattended while open to production. The provisions of this paragraph are not applicable to the testing and inspection procedures specified in section 2 (Design, Testing, and Inspection) above.

4. *Additional Protective Equipment.* All tubing installations in which a wireline- or pumpdown-retrievable subsurface safety device is to be installed shall be equipped with a landing nipple, with flow couplings or other protective equipment above and below, to provide for setting of the subsurface safety device. All wells in which a subsurface safety device or tubing plug is installed shall have the tubing-casing annulus packed off above the uppermost open casing perforations. insertion The control system for all surface-controlled subsurface safety devices shall be an integral part of the platform shut-in system.

4. **Additional Protective Equipment**. All tubing installations in which a wireline- or pumpdown-retrievable subsurface safety device is to be installed shall be equipped with a landing nipple, with flow couplings or other protective equipment above and below, to provide for setting of the subsurface safety device. All wells in which a subsurface safety device or tubing plug is installed shall have the tubing-casing annulus packed off above the uppermost open casing perforations, and at least 30 metres (100 feet) below the measured top of cement on the production string or the intermediate string. The control system for all surface-controlled subsurface safety devices shall be an integral part of the platform shut-in system.

5. **Departures**. All departure applications will be considered for approval pursuant to 30 CFR 250.12(b) and the requirements of this Order. All applications for departures shall include a detailed statement of the well conditions, efforts made to overcome any difficulties, and proposed alternate safety measures.

6. **Emergency Action**. All tubing installations open to hydrocarbon-bearing zones and not equipped with a subsurface safety device as permitted by this Order shall be clearly identified as not ~~being so equipped, and a subsurface safety device or tubing~~

764

plug shall be available at the field location. In the event of an emergency, such device or plug shall be promptly installed, due consideration being given to personnel safety.

7. **Records**. The operator shall maintain the following records for a minimum period of one year for each subsurface safety devices and tubing plug installed, and these records shall be available to any authorized representative of the Geological Survey.

A. **Field Records**. Individual well records shall be maintained at or near the field and shall include, as a minimum, the following information:

(1) A record which will give design and other information; i.e., make, model, type, spacers, bean and spring size, pressure, etc.

(2) Verification of assembly by a qualified person in charge of installing the device and installation date.

(3) Verification of setting depth and all operational tests as required in this Order.

(4) Removal date, reason for removal, and reinstallation date.

(5) A record of all modifications of design in the field.

(6) All mechanical failures or malfunctions, including sand cutting, of such devices, with notation as to cause or probably cause.

(7) Verification that failure report was submitted.

B. Other Records. The following records, as a minimum, shall be maintained at the operator's office:

(1) Verified design information of subsurface safety devices for the individual well.

(2) Verification of assembly and installation according to design information.

(3) All failure reports.

(4) All laboratory analysis reports of failed or damaged parts.

(5) Quarterly failure-analysis report.

8. Reports. Well completion reports (Form 9-330) and any subsequent reports of workover (Form 9-331) shall include the type and the depth of the subsurface safety devices and tubing plugs installed.

To establish a failure-reporting and corrective-action program as a basis for reliability and quality control, each operator shall submit a quarterly failure-analysis report to the Area Supervisor, identifying mechanical failures by lease and well, make and model, cause or probable cause of failure, and action taken to correct the failure. The report shall be submitted within 30 days following the periods ending December 31, March 31, June 30, and September 30 of each year.

Harry A. DuPont
Area Oil and Gas Supervisor

Approved:

Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
EASTERN AREA

MID-ATLANTIC OCS ORDER NO. 7

Effective ____________

POLLUTION AND WASTE DISPOSAL

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.43. The operator shall comply with the following requirements. All departures from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 250.12(b).

1. **Pollution Prevention**. In the conduct of all oil and gas operations, the operator shall prevent pollution of the ocean. Furthermore, the disposal of waste materials into the ocean shall not create conditions which will adversely affect the public health, life or property, aquatic life or wildlife, recreation, navigation, or other uses of the ocean.

   A. **Liquid Disposal**.

      (1) Drilling mud containing free oil shall not be disposed of into ocean.

      (2) The operator shall submit with the Application for Permit to Drill (Form 9-331C) a detailed list of

(3) Curbs, gutters, and drains on platforms and structures shall be installed and maintained in accordance with the provisions of OCS Order No. 8.

(4) Produced waste water disposal systems shall be designed and maintained so that the oil content of the effluent shall meet applicable requirements promulgated by the Environmental Protection Agency pursuant to the Federal Water Pollution Control Act as amended.

(a) A copy of the results of all analyses submitted to the Environmental Protection Agency shall be similarly submitted to the Area Supervisor, and a copy of the most recent analysis shall be maintained at the discharge site or field production headquarters and be available for inspection by Geological Survey personnel.

— revised

(b) Should an analysis indicate that the effluent does not meet the above requirements, corrective action shall be taken immediately. Approval to continue operations to aid in the identification and remedy of the problem shall be obtained from the Area Supervisor. Such approval shall be contingent upon submittal of a follow-up report to the Area Supervisor within 10 days.

(5) The disposal of produced waste water other than into the ocean shall have the method and location approved by the Area Supervisor.

B. Solid Waste Disposal.

(1) Drill cuttings, sand, and other solids containing oil shall not be disposed of into ocean unless all of the free oil has been removed.

(2) Mud containers and other solid waste materials shall be incinerated or transported to shore for disposal in accordance with Federal, State, or local requirements.

(3) All sewage shall be treated so that effluent shall meet applicable requirements promulgated by th Environmental Protection Agency pursuant to the Federal Water Pollution Control Act as amended.

(a) A copy of the results of all analyses submitted to the Environmental Protection Agency shall be similarly submitted to the Area Supervisor, and a copy of the most recent analysis shall be maintained at the discharge site or field production headquarters and be available for inspection by Geological Survey personnel.

-- deleted

(b) Should an analysis indicate that the effluent does not meet the above requirements, corrective action shall be taken immediately. Approval to continue operations to aid in the identification and remedy of the problem shall be obtained from the Area Supervisor. Such approval shall be contingent upon submittal of a follow-up report to the Area Supervisor within 10 days.

drilling mud constituents and their concentrations, including the chemical composition of trade name components, and a list of the drilling mud additives anticipated for use in meeting special drilling requirements. Drilling mud containing toxic substances shall be neutralized prior to disposal.

(3) Curbs, gutters, and drains on platforms and structures shall be installed and maintained in accordance with the provisions of OCS Order No. 8.

(4) Discharges from fixed structures including sanitary waste, produced water, and deck drainage are subject to Environmental Protection Agency permitting procedures pursuant to the Federal Water Pollution Control Act as amended.

B. Solid Waste Disposal.

(1) Drill cuttings, sand, and other solids containing oil shall not be disposed of into ocean unless all of the free oil has been removed.

(2) Mud containers and other similar solid waste materials shall be incinerated or transported to shore for disposal in accordance with Federal, State, or local requirements.

B. *Pollution Inspections.* All drilling and production facilities shall be inspected daily. All production facilities, such as separators, tanks, treaters, and other equipment shall be such as are necessary to control the maximum anticipated pressures and production of oil and gas. Maintenance or repairs as are necessary to prevent pollution of the ocean shall be undertaken immediately.

revised

2. **Personnel, Inspections and Reports.**

A. **Personnel**. The operator's personnel shall be thoroughly instructed in the techniques of equipment maintenance and operation for the prevention of pollution. Nonoperator personnel shall be informed in writing, prior to executing contracts, of the operator's obligations to prevent pollution.

B. **Pollution Inspection Schedules**. Operators shall inspect their facilities as follows:

(1) Manned facilities shall be inpected daily.

(2) Unattended facilities, including those equipped with remote control and monitoring systems, shall be inspected at frequent intervals. The Supervisor may prescribe the frequency of inspections for these facilities.

(3) All production facilities, such as separators, tanks, treaters, and other equipment shall be designed to prevent pollution. Maintenance or reparis necessary to prevent pollution of the ocean shall be undertaken immediately.

C. *Pollution Reports.* All pollution reports required shall be submitted on Form 9-1880, entitled *Pollution Report.*

(1) All spills of oil and liquid pollutants shall be recorded showing the cause, size of spill, and action taken, and the record shall be maintained and available for inspection by the District Supervisor. All spills of less than 2.4 cubic metres (15 barrels) shall be reported orally to the District Supervisor within 12 hours and shall be confirmed in writing.

(2) All spills of oil and liquid pollutants of 2.4 to 7.9 cubic metres (15 to 50 barrels) shall be reported orally to the District Supervisor immediately and shall be confirmed in writing.

insertion

(3) All oil spills of 2.4 cubic metres (15 barrels) or more shall also be reported to the Governor or his designee of each adjacent State within four hours.

(4) All spills of oil and liquid pollutants of a substantial size or quantity, which is defined as more than 7.9 cubic metres (50 barrels), and those of any size or quantity which cannot be immediately controlled, shall be reported orally without delay to the District Supervisor, the Coast Guard, and the Regional Administrator, Environmental Protection Agency. All oral reports shall be confirmed in writing.

revised

C. **Pollution Reports**. All pollution reports required shall be submitted on Form 9-1880, entitled **Pollution Report**.

(1) All spills of oil and liquid pollutants shall be recorded showing the cause, size of spill, and action taken, and the record shall be maintained and available for inspection by the District Supervisor. All spills of less than 2.5 cubic metres (15 barrels) shall be reported orally to the District Supervisor within 12 hours and shall be confirmed in writing.

(2) All spills of oil and liquid pollutants of 2.5 to 8 cubic metres (15 to 50 barrels) shall be reported orally to the District Supervisor within four (4) hours and shall be confirmed in writing.

(3) All spills of oil and liquid pollutants of more than 8 cubic metres (50 barrels) shall be reported orally without delay to the District Supervisor and the Coast Guard or the Regional Administrator, Environmental Protection Agency. The District Supervisor shall notify the Governor, or his designee, of all such spills without delay. All oral reports shall be confirmed in writing.

(4) Operators shall notify each other upon observation of equipment malfunction or pollution resulting from another's operation.

3. Pollution Control Equipment and Oil Spill Contingency Plan.

A. Equipment. Standby pollution control equipment and materials shall be maintained by, or shall be available to, each operator at an offshore or onshore location. This shall include containment booms, skimming apparatus, cleanup materials and chemical agents, and shall be available prior to the commencement of operations. No chemicals shall be used without prior approval of the Area Supervisor. The equipment and materials shall be inspected monthly and maintained in good condition for use. The results of the inspections shall be recorded and maintained at the site.

B. Oil Spill Contingency Plan. The operator shall submit an oil spill contingency plan for approval by the Area Supervisor before consideration can be given to approval of an application for permit to conduct operations. This plan shall contain the following:

(1) Provisions to assure that full resource capability is known and can be committed during an oil discharge

situation including the identification and inventory of applicable equipment, materials, and supplies which are available locally and regionally, both committed and uncommitted, and the time required for deployment.

(2) Provisions for varying degrees of response effort depending on the severity of the oil discharge.

(3) Establishment of notification procedures for the purpose of early detection and timely notification of an oil discharge including a current list of names, telephone numbers, and addresses of the responsible persons and alternates on call to receive notification of an oil discharge, as well as the names, telephone numbers, and addresses of regulatory organizations and agencies to be notified when an oil discharge is discovered.

(4) Provisions for well defined and specific actions to be taken after discovery and notification of an oil discharge including:

(a) Specification of an oil disharge response operating team consisting of trained, prepared and available operating personnel.

(b) Predesignation of an oil discharge response coordinator who is charged with the responsibility and delegated commensurate authority for directing and coordinating response operations.

(c) A preplanned location for an oil discharge response operations center and a reliable communications system for directing the coordinated overall response operations.

4. Spill Control and Removal. Immediate corrective action shall be taken in all cases where pollution has occurred. Corrective action taken under the Oil Spill Contingency Plan shall be subject to modification when directed by the Area Supervisor. The primary jurisdiction to require corrective action to abate the source of pollution and to enforce the subsequent cleanup by the lessee or operator shall remain with the Area Supervisor pursuant to the provisions of this Order and the memorandum of understanding between the Department of Transportation (U.S. Coast Guard) and the Department of the Interior (U.S. Geological Survey) dated August 16, 1971.

5. Annual Contingency Plan Assessment. Annual contingency plan assessments will be conducted in conjunction with Plan of Development review. Upon request of the Area Supervisor, revised contingency plans reflecting changes in personnel, equipment, and methods shall be submitted.

Harry A. DuPont

Area Oil and Gas Supervisor

Approved:

Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
EASTERN AREA

MID-ATLANTIC OCS ORDER NO. 12

Effective ____________________

PUBLIC INSPECTION OF RECORDS

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.97 and 43 CFR Part 2. Requests for information made under the Freedom of Information Act, 5 U.S.C. § 552, will be governed by the provisions of 43 CFR Part 2 (40 F.R. 7304, February 19, 1975). Section 2.13 of 43 CFR says:

> It is the policy of the Department of the Interior to make the records of the Department available to the public to the greatest extent possible, in keeping with the spirit of the Freedom of Information Act.

Section 2.15(c) of 43 CFR says:

> A request for a record may be denied only if it is determined that (1) the record is exempt from disclosure (under the Freedom of Information Act) and (2) that withholding of the record is required by statute or Executive Order or supported by sound grounds.

The operator shall comply with the following requirements. All departures from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 250.12(b).

1. Availability of Records. It has been determined that certain records pertaining to leases and wells in the Outer Continental Shelf and submitted under 30 CFR 250 shall be made available for public inspection, as specified below, in the Area office. Certain other portions of these records have been determined to be exempt from disclosure. The reason for these exemptions is discussed in Section 4 of this Order.

A. Form 9-152 - Monthly Report of Operations. All information contained on this form shall be available except the information required in the Remarks column.

B. Form 9-330 - Well Completion or Recompletion Report and Log.

(1) Prior to commencement of production, all information contained on this form shall be available, except Item 1a, Type of Well; Item 4, Location of Well, at top production interval reported below: Item 22, if Multiple Completion, How many; Item 24, Producing Interval; Item 26, Type Electric and Other Logs

Logs Run; Item 28, Casing Record; Perforation Record; Item 32, Acid, Shot, Fracture, Cement Squeeze, etc.; Item 33, Production; Item 37, Summary of Porous Zones; and Item 38, Geologic Markers.

revision

(2) After commencement of production, all information shall be available, except Item 37, Summary of Porous Zones; and Item 38, Geologic Markers.

(3) If production has not commenced after an elapsed time of five years from the date of filing Form 9-330 as required in 30 CFR 250.38(b) all information contained on this form shall be available, except Item 37, Summary of Porous Zones; and Item 38, Geologic Markers. Within 90 days prior to the end of the 5-year period, the lessee or operator shall

insertion

Run; Item 28, Casing Record; Item 29, Liner Record; Item 30, Tubing Record; Item 31, Perforation Record; Item 32, Acid, Shot, Fracture, Cement Squeeze, etc.; Item 33, Production; Item 37, Summary of Porous Zones; and Item 38, Geologic Markers.

(2) After commencement of production, all information shall be available, except Item 37, Summary of Porous Zones; and Item 38, Geologic Markers.

(3) If production has not commenced after an elapsed time of five years from the date of filing Form 9-330 as required in 30 CFR 250.38(b), excluding the total of such time that operations and production are suspended by direction of the Secretary of the Interior or his duly authorized representative, and further excluding the total of such time that operations and production are prohibited by Court Order, all information contained on this form shall be available, except Item 37, Summary of Porous Zones; and Item 38, Geologic Markers. Within 90 days prior to the end of the 5-year period, the lessee or operator shall file a Form 9-330 containing all information requested on the

form, except Item 37, Summary of Porous Zones; and Item 38, Geologic Markers, to be made available for public inspection. Objections to the release of such information may be submitted with the completed Form 9-330.

C. Form 9-331 - Sundry Notices and Report on Wells.

(1) When used as a "Notice of Intention to" conduct operations, all information contained on this form shall be available, except Item 4, Location of Well, at top production interval; and Item 17, Describe Proposed or Completed Operations.

(2) When used as a "Subsequent Report of" operations, and after commencement of production, all information contained on this form shall be available, except information under Item 17 as to subsurface locations and measured and true vertical depths for all markers and zones not placed on production.

D. Form 9-331C - Application for Permit to Drill, Deepen or Plug Back. All information contained on this form, and location plat attached thereto, shall be available except Item 4, Location of Well at Proposed Production

Zone; and Item 23, Proposed Casing and Cementing Production Program.

E. Form 9-1869 - Quarterly Oil Well Test Report. All information contained on this form shall be available.

F. Form 9-1870 - Semi-Annual Gas Well Test Report. All information contained on this form shall be available.

G. Multi-point Back Pressure Test Report. All information contained on this form used to report the results of required multi-point back pressure test of gas wells shall be available.

H. Sales of Lease Production. Information contained on monthly Geological Survey computer printout showing sales volumes, value, and royalty of production of oil, condensate, gas and liquid products, by lease, shall be made available.

2. Filing of Reports. All reports on Forms 9-152, 9-330, 9-331, 9-331C, 9-1869, 9-1870, and the forms used to report the results of multi-point back pressure tests, shall be filed in accordance with the following: All reports submitted on these forms shall include a copy with the words "Public Information" shown on the lower right-hand corner. All items on the form not marked "Public Information" shall be

completed in full; and such forms, and all attachments thereto, shall not be available for public inspection. The copy marked "Public Information" shall be completed in full, except that the items described in 1(A), (B), (C), and (D) above, and the attachments relating to such items, may be excluded. The words "Public Information" shall be shown on the lower right-hand corner of this set. This copy of the form shall be made available for public inspection.

3. Availability of Inspection Records. All accident investigation reports, pollution incident reports, facilities inspection data, and records of enforcement actions are also available for public inspection.

4. Information Exempt from Public Inspection. It has been determined that certain information as discussed in paragraphs 1.A, 1.B, 1.C, 1.D, and 2 of this Order is exempt from disclosure under exemption 9 of the Freedom of Information

Act (5 U.S.C. §552 (b)(9)). This information has been determined to qualify as "geological and geophysical information and data including maps concerning wells."

Harry A. DuPont
Area Oil and Gas Supervisor

Approved:

Russell G. Wayland
Chief, Conservation Division

OUTER CONTINENTAL SHELF

Guidelines to OCS Order No. 14

Introduction. The purpose of OCS Order No. "14" is to assure diligence in the development of the OCS's natural resources by allowing limited suspensions of operations or production while the operator is waiting for the installation of equipment or granting of permits necessary for the production or transportation of oil and gas from a lease. The standards in the Order are to be strictly applied, and a suspension should be granted only if the supervisor is satisfied that it will promote the development of the lease.

Although the supervisor may approve a request for suspension on several separate grounds, it is not intended that separate suspensions should be granted each time an operator meets the requirements of a separate category. For example, if an operator is waiting for equipment, but will also need a permit, whenever possible he should be required to do both at the same time, and should not get separate or successive suspensions for each.

Some of the types of factors that reflect on the operator's good faith and his actions to expedite production from the lease are listed below. These and other similar factors should be considered by the supervisor when he decides whether. to grant a suspension request.

For ease of reading, the relevant part of the draft Order is repeated within quotation marks, before the associated guidelines are presented.

SUSPENSIONS OF PRODUCTION TO FACILITATE PROPER DEVELOPMENT

A. . . . is waiting for completion of drilling platform construction and installation or delivery of equipment or facilities which are necessary for production and for which the lessee has signed a contract that specifies a delivery date; or

Guidelines. 1. Incomplete construction, or undeliverd equipment or facilities, is not by itself sufficient justification for granting a suspension. The operator shall show to the satisfaction of the supervisor:

(a) that the undelivered or incompletely installed equipment is essential for producing oil and gas from the lease; and

(b) that the operator has made a timely and diligent effort to obtain the equipment:

(c) that the delivery or completion date in the contract is reasonable. To decide whether the time for delivery or completion stated in the contract is reasonable, the supervisor should compare it with the time needed to perform similar contracts. Of course, he shall also consider any other information that may aid him in making his determination.

2. As a condition for the suspension the supervisor shall require the operator to continue doing any useful activity that will promote the early production of oil and gas from lease.

B. has pending before any Federal, State or local government authority, an application for a permit which is necessary before the lessee can produce oil or gas from the lease; or

Guidelines. 1. When granting suspensions under this provision it is important for the supervisor to be sure the provision is not being abused. The operator must show to the satisfaction of the supervisor that a bona fide application with a reasonable chance of success is involved. Successive applications made within a short period of time on the same or nearly the same terms as applications for permits or prices previously denied should not, for example, be considered bona fide applications.

2. Whenever possible, if more than one permit or license is necessary before the lessee can produce from the lease, the supervisor shall require that the operator submit all of the applications at the earliest possible time. Separate consecutive suspensions should not normally be granted for different applications when such applications can be acted upon during a single suspension period

3. If other useful activity can be performed while the application is under review, and the investment in that activity will not be lost if the application is not granted, the supervisor should require that the useful activity be continued while the permit application is pending.

C. has submitted to the Department of the Interior a development plan or unitization agreement for the lease and is waiting for the Department to complete action on the plan or agreement; or

Guidelines. 1. The operator must show to the satisfaction of the supervisor that a bona fide application or agreement with a reasonable chance of success is involved.

2. If other activity can be done while the permit application is under review, and the investment in such activity will not be lost if the permit is not granted, the supervisor shall require that the useful activity be continued while the permit application is pending.

D. has submitted to the Department of the Interior and is actually conducting a geological and geophysical exploration or development program that includes drilling to develop sufficient reserves to produce either from the lease alone or in connection with other leases. For purposes of receiving a suspension under this provision, drilling activity on one lease may be determined by the supervisor to be activity on all leases which are to be considered as a unit for purposes of providing sufficient reserves to establish economic justification for the construction of a pipeline necessary to transport such reserves from the subject leases.

Guidelines. 1. The purpose of this provision is to allow a suspension of a lease while the lessee is actively attempting to prove up enough reserves to justify a pipeline. To grant a suspension under these conditions, the supervisor shall require a report from the lessee showing:

(a) the specific leases to be considered as a unit for purposes of justifying the construction of a pipeline.

(b) the quantity of reserves already found on each lease.

(c) the minimum quantity of reserves required to justify the pipeline.

(d) an economic analysis showing how the estimated minimum quantity of reserves was determined and the assumptions used in arriving at the determination.

2. Mere proposals for further exploration do not meet the requirements of this section.

SUSPENSION OF PRODUCTION BECAUSE OF LACK OF TRANSPORTATION FACILITIES

A. . . . is waiting for the completion of pipeline construction, or delivery of pipeline equipment or facilities which are necessary for the transportation of oil and gas and for which the lessee has signed a contract that specifies the completion or delivery date, or

Guidelines. 1. An incomplete pipeline or undelivered equipment or facilities is not by itself sufficient justification for granting a suspension. The operator shall show to the satisfaction of the supervisor:

(a) that the undelivered or incompletely installed equipment is essential for producing oil and gas from the lease; and

(b) that the operator has made a timely and diligent effort to obtain the equipment; and

(c) that the delivery or completion date in the contract is reasonable. To decide whether the time for delivery or completion stated in the contract is reasonable, the supervisor should compare it with the time needed to perform similar contracts. He should also consider any other information that may aid him in making this determination.

2. As a condition for the suspension, the supervisor shall require the operator to continue doing any activity that will promote the early production of oil and gas from the lease.

B. . . . has pending before any Federal, State, local government authority an application or a permit which is necessary before the lessee can transport oil and gas from the lease, or

1. The operator must show to the satisfaction of the supervisor that a bona fide application with a reasonable chance of success is involved. Successive applications made within a short period of time on the same or nearly the same items as applications for permits or prices previously denied should not, for example, be considered bona fide applications.

2. Whenever possible, if more than one permit or license is necessary before the lessee can produce from the lease, the supervisor shall require that the operator submit all of the applications at the earliest possible time. Separate consecutive suspensions should not normally be granted for different applications can be acted upon during a single suspension period.

3. If other useful activity can be performed while the application is under review, and the investment in that activity will not be lost if the application is not granted, the supervisor should require that the useful activity be continued while the permit application is pending.

C. . . . has a contract to use an existing pipeline, but is unable to use the pipeline for reasons beyond the lessee's control.

Guidelines. 1. The operator must show that he has not caused or contributed to his inability to use the pipeline. Suspension of rights to operate by State agencies or acts of God may justify a suspension under this section.

2. If a suspension is granted, the supervisor shall require the operator to seek alternative means of transportation.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

OCS ORDER NO. 14

EFFECTIVE ______________________

APPROVAL OF SUSPENSIONS OF PRODUCTION

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.12(d).

If the supervisor in his discretion approves a request for suspension of production pursuant to 30 CFR 250.12(d)(i) and (ii), the terms of the lease will not be deemed to expire as long as the suspension remains in effect.

The supervisor may not approve a request for a suspension to facilitate proper development or for lack of transportation facilities unless he is satisfied that the lessee: (1) has made the request in good faith; and (2) is taking and will continue to take all reasonable actions to expedite the production of oil and gas from the lease.

1. *Suspension of Production to Facilitate Proper Development*. A lease on which a well has been drilled and determined by the supervisor to be capable of being produced in paying quantities according to the provisions of OCS Order No. 4 and thereafter temporarily abandoned or permanently plugged and abandoned is being properly developed if the lessee:

A. Is waiting for completion of drilling platform construction and installation, or delivery of equipment or facilities which are necessary for production and for which the lessee has signed a contract that specifies a delivery date; or

B. Has pending before any Federal, State, or local government authority, an application for a permit which is necessary before the lessee can produce oil or gas from the lease; or

C. Has submitted to the Department of the Interior a development plan or unitization agreement for the lease and is waiting for the Department to complete action on the plan or agreement; or

D. Has submitted to the Department of the Interior and is actually conducting a geological and geophysical exploration or development program, that includes drilling to develop sufficient reserves to produce either from the lease alone, or in connection with other leases. For purposes of receiving a suspension under this provision, drilling activity on one lease may be determined by the supervisor to be activity on all leases which are to be considered as a unit for purposes of providing sufficient reserves to establish economic justification for the construction of a pipeline necessary to transport such reserves from the subject lease.

2. *Suspension of Production Because of Lack of Transportation Facilities*. A lease on which a well has been drilled and determined by the supervisor to be capable of being produced in paying quantities, according to the provisions of OCS Order No. 4, and thereafter temporarily abandoned or permanently plugged and abandoned, cannot be produced because of lack of transportation facilities if the lessee:

A. Is waiting for the completion of pipeline construction, or delivery of pipeline equipment or facilities which are necessary for the transportation of oil and gas and for which the lessee has signed a contract that specifies the completion or delivery date; or

B. Has pending before any Federal, State, or local government authority an application or a permit which is necessary before the lessee can trasport oil and gas from the lease; or

C. Has a contract to use an existing pipeline, but is unable to use the pipeline for reasons beyond the lessee's control.

____
Oil and Gas Supervisor

Approved: December 12, 1975.

EDDIE R. WYATT,
Acting Chief, Conservation Division.

[FR Doc.75-34199 Filed 12-18-75;8:45 am]

From Federal Register, Vol. 40, No. 213 -- Tuesday, November 4, 1975

APPENDIX 12

TITLE 30--MINERAL RESOURCES

CHAPTER II--GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

PART 250--OIL AND GAS SULPHUR OPERATIONS IN THE OUTER CONTINENTAL SHELF

Drilling and Development Programs

On pages 42559 and 42560 of the September 15, 1975, edition of the FEDERAL REGISTER (40 FR 42559--42560) there was published a proposal to modify regulation 30 CFR 250.34, Drilling and Development Programs. Page 43036 of the September 18, 1975, edition (40 FR 43036) contained a correction. The intent of the proposed modification is to set forth procedures for State consideration of developments proposed by lessees of Federal Outer Continental Shelf Lands. The proposed modification will provide affected States with information and an opportunity to review and comment concerning developments of oil and gas by such lessees. Lessees will be required to deliver information on planned developments to affected States before submitting development plans to the U.S. Geological Survey.

The regulation recognizes that development plans often contain information which the lessee considers to be confidential. Two specific classes of information often contained in development plans are exempted from disclosure under the Freedom of Information Act. These will not be disclosed under the proposed modification.

The Outer Continental Shelf Lands Act (43 U.S.C. 1331-1343) provides in section 5(b) (2) that leases may be cancelled for failure to comply with "regulations issued under this Act and in force and effect on the date of issuance of the lease." In keeping with this provision, the revised regulation 30 CFR 250.34 herein promulgated will be applicable only to leases issued after the date of this rulemaking.

Interested persons were given until October 15, 1975, to submit comments regarding the proposed modification of 30 CFR 250.34. The notice of the proposed modification indicated that signficant comments would be published at the time of the final rulemaking. Because of the volume of the comments received, they are not published herein but are available on request from the Director of the U.S. Geological

Survey, National Center, Reston, Virginia 22092. The comments received represented a wide range of views on the necessity, value, legality and consequences of the proposed modification.

After considering the comments received the following revisions were made in the proposed modifications:

1. Added provisions to paragraphs (b) and (c) allowing States to waive review of development plans and receipt of information.

2. Added provisions to paragraphs (b) and (c) requiring that Governors' comments on development plans and information be sent to both the Supervisor and the lessee.

3. Added a procedure to paragraph (b) for treatment of amendments to development plans made before their approval.

4. Clarified requirements for information under paragraph (c). (Further clarification will be forthcoming in relevant OCS Orders).

5. Added a provision to paragraph (c) which allows previously published information to be incorporated by reference rather than duplicated in the information for States.

6. Added a provision to paragraph (c) providing for extension of the term of the lease in cases where review requires delays in excess of the 60-day period.

7. Added to paragraph (e) the condition that the Supervisor determine that proposed modifications of approved development plans significantly affect the interest of a State before requiring that the procedures under paragraphs (b) and (c) be applied.

The proposed modification to 30 CFR 250.34 is adopted as set forth below and is effective immediately. OCS Orders will be issued subsequently to define more specifically the content and timing of information to be provided by lessees to the States.

Thomas S. Kleppe,
Secretary of the Interior.

October 31, 1975.

Section 250.34 is revised to read as follows:

#250.34 Drilling and development programs.

(a) Exploratory drilling plan. Prior to commencing each exploratory drilling program on a lease, including the construction of platforms, the lessee shall submit a plan to the Supervisor for approval. Each plan for the leased area shall include (1) a description of drilling vessels, platforms, or other structures showing the location, the design, and the major features thereof, including features pertaining to pollution prevention and control; (2) the general location of each well including surface and projected bottom hole location for directionally drilled wells; (3) structural interpretations based on available geological and geophysical data; and (4) such other pertinent data as the Supervisor may prescribe.

(b) Development plan. Prior to commencing each development program on a lease, the lessee shall submit a plan to the Supervisor for approval. The plan shall include all information specified in paragraph (a) of this section in detail. The development plan except for those portions which the lessee shall designate, with the Supervisor's approval, as (1) trade secrets and commercial or financial information which are privileged or confidential or (2) geological and geophysical information, data and maps concerning wells, shall be provided by the Supervisor to the Governors of directly affected States, as designated by the Supervisor. Any State not wishing to review a development plan may so indicate to the Supervisor. Prior to the Supervisor's approval of the plan, a period of 60 days, commencing with the date of the Governors'receipt of the development plan, shall be provided to each Governor for review of the plan and the submission of comments, to both the Supervisor and the lessee. If the Governors' comments are received before the 60 day period ends, the Supervisor may then proceed to act upon the plan without further delay. After the 60 day period ends, the Supervisor may act upon the plan even if comments have not been received from the Governor. Amendments to development plans may be submitted during the period before this approval. Such amendments shall be sent by the Supervisor to the Governors who have received copies of the development plans. In such cases, the Supervisor shall determine if the amendment is significant and warrants an extension of the 60 day review period.

(c) Information for States. Prior to submission of a development plan, the lessee shall deliver to the Governor of each directly affected State, as designated by the Supervisor, information about the development to be proposed. Any State not wishing to have such information may so indicate to the Supervisor. The final delivery of such information shall be made at least 30 days before submission of the relevant development plan, at which time the lessee shall notify both the Governor of each directly affected State and the Supervisor that such final delivery has been made. When submitting a development plan, the lessee shall certify to the Supervisor that he has, at least 30 days before such submission, provided the required information about the development proposed in that plan to the Governor of each directly affected State. The information provided to the States under this paragraph (c) which is not to be a part of the development plan itself, shall include a description of all offshore and onshore facilities and operations proposed by the lessee or directly related to the proposed development including location, size, requirements for land, labor, materials and energy, and timing of development and operation, and other related information as may be required by the Supervisor. Information available in previously published documents, such as Environmental Impact Statements, may be incorporated by reference. Copies of all information given to Governors under this paragraph shall be provided to the Supervisor. A State provided such information shall indicate to the Supervisor and to the lessee at the earliest practicable time whether the State concurs that the information meets the requirements of this paragraph and any subsequent implementing Orders issued by the Supervisor. If a State fails to provide such notification within 30 days after final delivery of the information, the State's concurrence will be conclusively presumed. If a State notifies the Supervisor that the information does not in its judgment satisfy the requirements, then the Director shall review the information, the specific comments of the Governor, and the position of the lessee and shall make a determination either that the information satisfies the requirements or that the lessee must provide additional information. The Director shall make his review and determination as expeditiously as possible after receipt of such notification. In the event the Director determines that the information satisfies the requirements, then the 60 day period for comments shall begin on the date of his determination. In the event the Director determines that the requirement has not been satisfied, the 60 day comment period will not begin until the State shall have received the additional information required. If, with respect to any non-producing lease, the procedures specified under paragraphs (B) and (C) require delay in excess of the 60 days for review specified in those paragraphs, and the delay is in the interest of conservation and is not caused by the lessee, there shall, if the lessee so requests, be a suspension of operations for a period equal to the delay in excess of 60 days and the lease shall be extended for a period of time equal to the period of suspension.

(d) Drilling applications. Prior to commencing drilling operations either under an exploratory or development plan, the lessee shall submit an Application for Permit to Drill (Form 9-331C) to the Supervisor for approval. The application shall include the integrated blowout prevention, mud, casing and cementing program for the well, and shall meet the requirements specified in #250.41(a), and contain the information specified in #250.91(a), and shall conform with the approved exploratory or development plan.

(e) Modifications. The lessee shall submit: (1) All requests for modifications of an approved exploratory or development plan in writing to the Supervisor for approval and (2) all notices of changes to plans set forth in approved Application for Permit to Drill on Sundry Notices and Reports on Wells (Form 9-331), except that these requirements shall not relieve the lessee from taking appropriate action to prevent or abate damage, waste, or pollution of any natural resource or injury to life or property. When the Supervisor shall determine that the proposed modification of an approved development plan is major and would directly and signficantly affect the interest of a State, he shall require the lessee to follow the same procedures with respect to the State as those provided in #250.34(b) and (c).

☆ U.S. GOVERNMENT PRINTING OFFICE : 1976 O - 207-398